DESIGN AND DEVELOPMENT OF FACE DETECTION SYSTEM FOR AUTO LIFTER ROSTRUM

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Date : 6th JUNE 2018

DESIGN AND DEVELOPMENT OF FACE DETECTION SYSTEM FOR AUTO LIFTER ROSTRUM

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A report submitted in partial fulfilment of the requirements for the

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2018

"I declare that this report entitle" **Design and Development of Face Detection System for Auto Lifter Rostrum** "is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree"

Mechatronics Engineering"

Signature : ……

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Date : 6th JUNE 2018

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ABSTRACT

The innovation on the many daily products is an on-going process and is never going to end as long as there are demands for better and more efficient method of doing something. This project focuses on a particular innovation of the rostrum which is the height adjustment. Rostrum is a rigid body furniture that are used for speakers to place important documents during speeches. The study intends to produce an automated height adjustment with face detection system for the rostrum so that different body statures of speakers could be adjust accordingly. Studies have been made on previous rostrum designs and the height adjustable mechanisms that were apply in the rostrum designs. The height adjustments in the rostrum designs are usually manually-controlled which requires a person to pre-set the height or manually adjust it. From the references, few conceptual designs are generated and selected. The fabrication of the project takes place to create the desired automated height adjustment mechanism. The face detection system is mainly used for the height adjustment of the rostrum. As per the analysis showing, the average accuracy of face detection system is from 97.95% to 99.57%, this was the average result which gained from the analysis of face detection system accuracy. Speed of the motor which used for this rostrum was calculated by repeating the height test for different people and the time taken to adjust the height, from the result gain, the speed of the motor which used for the rostrum is 0.0194 m/s. the result showing the system able to adjust the height by detecting speaker's face accurately and reliable. In a nutshell auto lifter rostrum with face detection system will be the smart system in future for speaker who will be using rostrum. The project hopes to provide better comfort and efficiency when the speaker is giving his or her speech.

ABSTRAK

Inovasi pada banyak produk harian adalah proses yang berterusan dan tidak akan berakhir selagi ada tuntutan untuk kaedah yang lebih baik dan lebih cekap melakukan sesuatu. Projek ini memberi tumpuan kepada inovasi tertentu rostrum yang merupakan pelarasan ketinggian. Rostrum adalah perabot badan yang tegar yang digunakan untuk penceramah untuk meletakkan dokumen penting semasa ucapan. Kajian ini bertujuan untuk menghasilkan pelarasan ketinggian automatik dengan sistem pengesanan muka untuk rostrum supaya statur badan yang berbeza dari pembesar suara dapat disesuaikan dengan sewajarnya. Kajian telah dibuat pada reka bentuk rostrum sebelumnya dan mekanisme laras ketinggian yang digunakan dalam reka bentuk rostrum. Pelarasan ketinggian dalam reka bentuk rostrum biasanya dikawal secara manual yang memerlukan seseorang untuk menetapkan ketinggian atau menyesuaikannya secara manual. Daripada rujukan, beberapa reka bentuk konseptual dihasilkan dan dipilih. Pembuatan projek ini dibuat untuk mewujudkan mekanisme penyelarasan ketinggian automatik yang diinginkan. Seperti yang ditunjukkan dalam analisis, ketepatan purata sistem pengesanan muka adalah dari 97.95% hingga 99.57%, ini adalah hasil purata yang diperoleh daripada analisis ketepatan sistem pengesanan muka. Kelajuan motor yang digunakan untuk rostrum ini dikira dengan mengulangi ujian ketinggian untuk orang yang berlainan dan masa yang diambil untuk menyesuaikan ketinggian, dari keuntungan hasil, kelajuan motor yang digunakan untuk rostrum ialah 0.0194 m / s. Hasilnya menunjukkan system ini dapat menyesuaikan ketinggian dengan mengesan wajah pembicara dengan tepat dan boleh dipercayai. Secara ringkasnya alat pengangkat gerudi auto dengan sistem pengesanan muka akan menjadi sistem pintar di masa depan untuk pembicara yang akan menggunakan rostrum. Projek ini berharap dapat memberikan keselesaan dan kecekapan yang lebih baik apabila pembicara memberi ucapannya.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	ABSTRACT	i-ii
	TABLE OF CONTENTS	iii-vi
	LIST OF TABLES	vii
	LIST OF FIGURES	viii-x
	LIST OF SYMBOLS	xi
	LIST OF ABBREVIATIONS	xii
1	**INTRODUCTION**	
	1.1 Project Background	1-3
	1.2 Project Motivation	3-4
	1.3 Problem Statement	4
	1.4 Project Objectives	5
	1.5 Project Scope	5
	1.6 Report Outline	5-6
2	**LITERATURE REVIEW**	
	2.1 Introduction	7
	2.2 Rostrum	7-10
	2.3 History and Development of Rostrum	10-17
	2.4 Transmission Mechanism	17-18
	2.4.1 Lead Screw	18
	2.4.2 Ball Screw	19-20
	2.4.3 Transmission Mechanism Parameter Consideration	20

2.4.3.1 Load 20
2.4.3.2 Back Power 20-21
2.4.3.3 Driving Torque 21
2.4.3.4 Accuracy 21-22
2.4.3.5 Lead 22
2.4.3.6 Life 22
2.4.3.7 Backlash 23
2.4.3.8 Wipers 23
2.4.4 Lead screw vs. Ball screw 24
2.4.5 Gear 25-29
2.4.6 Belt 29
2.4.6.1 V-Belt Driver 29-30
2.4.6.2 Toothed Belt 30-31
2.4.7 Chain Drives 32
2.4.8 Cams 33-34
2.5 Sensor 35
2.5.1 Proximity sensor 35-36
2.5.1.1 Photoelectric sensor 36-39
2.5.1.2 Capacitive Proximity sensor 39-40
2.5.1.3 Ultrasonic Proximity sensor 41-43
2.5.1.4 Inductive Proximity sensor 43-44
2.5.2 Vision System 44-46
2.5.3 Face Detection system 46-48
2.6 Height Adjustment Mechanism 48
2.6.1 Power Windows 48-49
2.6.2 Aerial Work Platform 49-50
2.7 Controller 51
2.7.1 Arduino Controller 51-52
2.7.2 Raspberry Pi 53-54
2.8 Summary 55-56

3	**METHODOLOGY**		
	3.1 Introduction		57
	3.2 FYP Flow Chart		57-62
	3.3 Process Flow		63-65
	3.4 Concept and Idea		66
		3.4.1 Design	66-68
		3.4.2 System Development	69
	3.5 Component Selection		70
		3.5.1 Arduino Uno	70-71
		3.5.2 Raspberry Pi	72
		3.5.3 Relay Module	72
		3.5.4 DC Motor	73
		3.5.5 Lead Screw and Coupling	73-74
		3.5.6 Switches	74-76
		3.5.7 Combination of Components	76
	3.6 Experiment Setup		77
		3.6.1 Experiment of Height Accuracy	77-78
		3.6.2 Experiment of Determining Accuracy on Face Detection	78-79
		3.6.3 Experiment of Height vs Time	79
		3.6.4 Experiment of Light Intensity vs Accuracy	80
		3.6.5 Experiment of Camera Positioning	80-81
4	**PREMILINARY RESULTS**		
	4.1 Introduction		82-83
	4.2 Analysis		83
		4.2.1 Analysis of Accuracy on Face Detection	83-86
		4.2.2 Analysis of Light Intensity vs Face Detection Accuracy	86-89
		4.2.3 Analysis of Pi Camera Positioning	89-92

	4.2.4	Analysis of Height Accuracy	92-96
	4.2.5	Analysis of Height vs Time	96-100
5	**CONCLUSION AND RECOMMENDATION**		
	5.1 Conclusion		101-
	5.2 Future Recommendation		102
			102-
			103
REFERENCES			104-
			107
APPENDIXES			108-
			112

LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Comparison between lead screw and ball screw	24
2.2	Basic gear type comparison	28
2.3	Photoelectric modes with advantages and disadvantages	38
3.1	Gantt chart for FYP 1	61
3.2	Gantt chart for FYP 2	62
4.1	List of Experiment	83
4.2	Result of the Accuracy of Face Detection	84
4.3	The Result of the Accuracy of Face Detection at Different Places	88
4.4	The Result of the Camera Positioning Test	91
4.5	The Result of the Height Accuracy Test	95
4.6	Result of the Height vs Time Test	98
4.7	Speed of the motor	98

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Rostrum	2
2.1	Old Fashioned Rostrum	8
2.2	The Rostra Vetera	9
2.3	Manual vertically adjustable lectern	10
2.4	Longitudinal shafts with segments of worm gear	11
2.5	Upward and Downward position of the rostrum	11
2.6	Wooden Lecterns	12
2.7	Non-swiveling pneumatic lectern at front and bottom perspective	13
2.8	Modern lectern	14
2.9	Display of different functions of the modern lectern	15
2.10	Lectern suitable for disable in wheelchair	16
2.11	Height mechanism and movable desk top of the design for different users	16
2.12	Modern Lectern with touch screen technology	17
2.13	Lead Screw mechanism	18
2.14	Design of Ball Screw	19
2.15	Gear meshing	25
2.16	Gear train of three gears	27
2.17	Multi V-belt Drive	30
2.18	Toothed belt Drive	31
2.19	The Chain Drive	32
2.20	Cams: (a) elliptic, (b) heart-shaped, (c) pear-shaped	34
2.21	Follower (a) point, (b) knife, (c) roller, (d) sliding and oscillating, (e) flat, (f) mushroom	34

2.22	Photoelectric sensor	37
2.23	Capacitive Proximity sensor	40
2.24	Ultrasonic sensor and its reflecting wave	41
2.25	Illustration of inductive sensor by a sensor company	43
2.26	Shielded inductive sensor (left) and unshielded inductive sensor (right)	44
2.27	Basic vision system	45
2.28	Face detection using Template matching	47
2.29	Window lifting mechanism	49
2.30	Cherry Picker	50
2.31	Scissor lift illustration	50
2.32	Arduino (uno) controller	52
2.33	Raspberry Pi	53
3.1	The flow of the project development for FYP	59-60
3.2	Process flow chart of the project	63-64
3.3	Design Flow chart	67
3.4	Design Selection	67
3.5	The finalised design of the rostrum	68
3.6	Human eye corner point detection	69
3.7	Arduino Uno	71
3.8	Circuit Design	71
3.9	Relay Module	72
3.10	DC Geared Motor	73
3.11	Lead Screw with Coupling	74
3.12	Start and Stop button	75
3.13	Upper and Lower Limit Switch	76
3.14	The complete Rostrum	76
3.15	The three different position of pi camera	81
4.1	Experimental setup for the Face Detection	84
4.2	Graph of Face Detection Accuracy vs Different Human Face	85
4.3	Graph of Average Face Detection Accuracy vs Different Human Face	85

4.4	Light intensity	86-87
4.5	Graph of Face Detection Accuracy vs Light Intensity	88
4.6	Bar Chart of Average Face Detection Accuracy vs Light Intensity	89
4.7	Position of camera	90
4.8	Bar Chart of Angle of the Camera Position vs Comfortability Rating	91
4.9	Five People with Different Height	92
4.10	Circuit Design	93
4.11	Rostrum and 'X' Labelled area	94
4.12	Bar Chart of People with Different Height vs Height of Rostrum Stopped	95
4.13	Graph of People with Different Height vs Average Height of Rostrum Stopped	96
4.14	The Standing Position of Human in Front of Rostrum	97
4.15	Graph of Distance vs Time	99
4.16	Bar chart for Speed of the Motor for Five Persons Test	99
4.17	Bar Chart of the Average Speed of the Motor	100

LIST OF THE SYMBOLS

γ = Wavelength

C = Speed Of The Light

E = Energy

F = Frequency

H = Planck's Constant

Td = Driving torque (Newton. meter)

P = Load (Newton)

L = Lead of screw (meter/revolution)

e = Ball bearing screw efficiency (approximately 0.9 for ball screw, 0.4 for acme screw with plastic nuts, and 0.25 for acme screw with bronze nuts)

W = Angular velocity

n = Number of teeth

d = Diameter

Bs = Model Pixel At Background S

D = Distance

Is,T = Made Of Static Background

Xt(S) = Motion Level Field At Time

T = Threshold

LIST OF ABBREVIATIONS

CNN = Convolutional Neural Network

SVM = Support Vector Machine

ROI = Region of Interest

HOG = Histogram Oriented Gradient

DPM = Deformable Part Model (DPM)

TP = True Positive

TN = True Negative

FP = False Positive

FN = False Negative

CHAPTER 1

INTRODUCTION

This chapter provides an introduction on the project entitled, “Design and Development of Face Detection System for Automatic Lifter Rostrum”. Rostrum is a rigid column body furniture that provides a space for the speakers to put their notes and other speech material during a speech. The chapter include covered the background of the project, motivation of the project, problem statement, objectives and scope. In depth discussion on the project will be highlighted in later chapters.

1.1 Project Background

Historically, rostrum is a platform used by the speakers inside the Roman forum for public orators, and it becomes typically adorned with the prows of captured enemy ships. Nowadays, the time period rostrum refers to wooden fixtures with a base joint with a vertical column up to the desk in which the crucial files are positioned and the microphone is typically placed (Figure 1.1). Enhancing in living requirements and the search of recent creative and innovative technology calls for better characteristic of this product. On this remember, the values for ergonomic is brought to improve the factors of the podium and one of the most important concept may be carried out is to have an automatic peak adjustable mechanism, which suits special users characteristics.

Figure 1.1 Rostrum

There are many flaws of the rostrum inside the market nowadays may be taken into consideration when doing research. The fundamental troubles that befell inside the contemporary rostrum layout are heavy and hard to move, majority rostrum has a fixed peak, manually adjustable top of microphone, no pointer on rostrum for presentation, majority rostrum does now not have display for text/speech, microphone doesn't observe personal motion, there's no wheels at the lower part of rostrum for clean transportation as the list in [1][2].

The first trouble is the rostrum is difficult or solid in accordance with transit fit according to the rostrum forlorn no wheels. Ordinary rostrums generally committed beside wood then wood products namely a strong part over furnishings capable concerning adjusted barring anybody extra support. But the trouble is as the rostrum turns into also heavy. So by way of existence severe and no longer grudging any wheels, that creates a problem because shifting the rostrum. More manpower pleasure remain wanted according to transit the rostrum.

Normally rostrum inside the marketplace doesn't have screen display that makes it less difficult for the speaker to talk without having to peer his or her notes. Usually, speakers use cue cards to supply speeches in a greater prepare manner. Every so often the speakers can wander off within the cue card looking for his or her notes [3]. This

may create panic and growth level fright inside the speaker. This will destroy the speech. Rostrum with display ought to remedy the problem.

Presently in the market, majority rostrum does not have a pointer for presentation functions. The trouble creates while an extra man or woman is wanted to navigate the slides. This is an instance of crucial feature as it could be used for more than one displays even for paper presentation.

Usually, the modern rostrum is manually adjusted and for the grasp of rite his or her want to manually regulate the rostrum after every speaker. There is much other trouble whilst the speaker movements to and from but the microphones stays constant. No remarks happens causes the microphone to be regular. This affect the voice projection of the speaker to be disturbed which limits the movement of the speaker.

Often, at lectures or speeches there may be some of human beings with a view to supply the lecture or speech to the listening audience and in the event that there is a special in frame stature in peak of the speakers, the podium may be without difficulty adjusted to suit the precise speaker at any individual time. The want of this specific technology in the rostrum may be studied can achieved within the challenge. Height adjustment generation in rostrum isn't always something new and because of that the examine will awareness on an innovative idea of creating the mechanism computerized.

1.2 Project Motivation

Rostrum is a platform or a reading desk with a slanted top that used for public orators, a stage for public speaking, usually placed on a stand or affixed to some other forms of support on which documents or books are placed as support for reading aloud or lecture. Rostrum is also called as lectern that been used by speakers, lecturers or leaders to convey messages, to give lecture and speech, to speak formally to a crowd.

Nowadays, the rostrum is use for formal ceremonies such as meetings, award ceremonies, political events and others. Rostrum is always must in any speaking venue and it is also an effective way to give out information. Rostrum tends to attract attention from the audiences or crowd. People would listen to the speaker once the speaker is on the podium. It is a best way to attract attention of peoples.

1.3 Problem Statement

The rostrum is a furniture frequently used by a speaker to place the objects including reviews, speech notes, laptop and others for the reason of assisting the progress of the speech. Historically, rostrum is constructed with a selected material from top to bottom and in different heights.

Consequently, extraordinary speakers sometimes while giving speech could need to alter themselves which will be as relaxed as viable in turning in their speech. In lengthy speeches or long lectures, this will create difficulties and pain to the speaker and a lengthen exposure could create a fitness associated problem [1]. For example, a speaker who are too tall for the lectern will face difficult and not comfortable to deliver the speech whereas a speaker that is too short will need to strain on their self to reach the microphone in lectern and the lectern may also may not be comfortable for the speaker.

A rostrum with the maximum fundamental fee could have a height adjustable mechanism which permits appropriate range of height options to be performed. This may let the speech or lecture to be easily deliver to audience who are listening without the need to fear approximately backache or any fitness associated hassle [2]. By accomplishing this lectern, the fee of the rostrum may be the focusing factor for improvement. The important fact, that the rostrum is aesthetically fascinating because the target audience attention may be centred on the rostrum and the speaker while the speech or lecture is being brought.

1.4 Project Objective

The objectives of this project are:

i. To design an automatic lifting rostrum with face detection method.
ii. To develop the automation system of rostrum by using face detection system.
iii. To analyse the efficiency of the automated rostrum with face detection system.

1.5 Project Scope

The scopes of this project are:

i. Cover the studies on the principle of image processing.
ii. Raspberry Pi is used for face detection and Arduino used as a controller to develop a program which to control the movement of the motor.
iii. The proposed design is only suitable for average sized human (170cm – 195cm) from around the world.
iv. Limitation of height of the rostrum is minimum (103 cm) and maximum (133 cm)
v. The limitation of the user is just one person at time.

1.6 Thesis Outline

This thesis consists of 5 main chapters. Firstly, the title of the project was confirmed at the initial stage. This thesis starts with the chapter 1 that is an introduction. The first chapter discussed the overview of the project background, motivation, problem statement, objective, scope, and the expected outcome of the project. Then this thesis is continued with the second chapter literature review. Chapter 2 discussed literature review that is related to this project based articles, journal, books, and internet. In this particular chapter, it is discussed briefly the fact, technique components and materials used from the previous studies. Next in chapter 3 is the methodology described the planning of design structure, methods going to use,

procedures of experiment going to be done throughout the project and controller such as Arduino. Chapter 4 discussed the results and analysis with construct a table. The results obtained from the project will be analysed in this chapter. Finally, chapter 5 is discussed the project achievement and future recommendation.

CHAPTER 2

LITERITURE REVIEW

2.1 Introduction

This chapter provides the literatures and facts associated with the automated peak adjustable rostrum. The reason of this chapter is to check the important and fundamental idea, layout and manufacturability of the proposed product. In this chapter, topics which might be of significance to the challenge are highlighted including sensors, mechanisms, materials and designs.

2.2 Rostrum

Consistent with the Concise Oxford English Dictionary (11th version), a rostrum is defined as a raised platform on which someone stands to make a public speech, play track or conduct an orchestra. Rostrum is a vertical stand used for containing critical documents at the pinnacle whilst a speech is being brought (Figure 2.1). Beyond protecting notes, rostrum provides a leaning surface for speaker and provides a safety barrier among the speaker and the audience. It gives the location for the speaker to prepare the materials related to the speech and once in a while to expand the voice of the speaker via a microphone.

Figure 2.1: Old Fashioned Rostrum

The phrase “Rostrum” is derived from the time period “Rostra” (plural for rostrum). In line with William Smith (1875) in his e-book of, A Dictionary of Greek and Roman Antiquities, rostra was the call applied to stage in the Roman forum, from which the orators addressed the general public [4]. The name of Rostra was received after the belief of the remarkable Latin warfare, while it was embellished with the beaks (rostra) of the ships of the Antiates. Whilst the Romans captured an enemy galley, the rostrum of the boat become ravaged and returned to Rome as a warfare prize and these Rostra had been then used to beautify the audio system’s platform inside the Roman discussion board.

Rostra is situated between the Comitium location of meeting of the curies and the forum or vicinity of meeting for the tribes, so that the speaker might also deal with both facets. The form of the Rostra took the form of a round building with raised arches and a stand or platform on the pinnacle bordered by using a parapet [4]. The Rostra can be accessed by way of steps, one on every side alike the churches in Rome in which the preacher ascends at the east facet and descent at the west side. This permits the orators to walk from side to side while addressing his target audience. The

following determine suggests the example of the Rostra Vetera, as derived by Einar Gjerstad, a Swedish archaeologist of the historic Mediterranean.

Figure 2.2: The Rostra Vetera

Lectern is derived from the Latin phrase "lectus", beyond participle of "legere", which means that to study. A lectern is a stand upon which a speaker could area books or notes to permit the speakers to deliver the scripture, reading, lecture or sermon. In academics, the lecterns are generally prepared microphone, audio-visual controls and recording systems to permit higher comfort for the audio system to deliver their speech [5]. Every so often, computer also can be located on the academic lecterns as many come equipped with strength outlet at the lectern panel. In church buildings, the lecterns are commonly used because the bible rest to deliver sermons for the duration of the carrier. The biblical scriptures are examine with the aid of a bishop, priest, minister or different non secular instructors to talk to the church congregation.

Rostrum is a speaker's platform where the speaker ornate supplies the speech. Lectern is analysing stand or desk upon which e book or be aware are positioned to permit one, generally a preacher r lecturer to read at the same time as status up (Oxford Dictionary). The time period for both the podium and the lectern are similar and

physically alike [6]. Consequently, the term rostrum and lectern may be used interchangeable throughout the text to healthy distinctive subject matter of dialogue.

2.3 History and Development of Rostrum

Within the year 1956, a manually adjustable rostrum changed into patented by Waddie M. Toney *et al*. to provide vertical adjustable motion to healthy men and women with extraordinary sizes without the want of disassembling and reassembling any part of the rostrum as shown in Figure 2.3. The rostrum may be adjusted by means of the speaker via rotating a cope with or crank (21) placed at the ahead aspect rostrum which turns the longitudinal extending shaft established on the bottom.

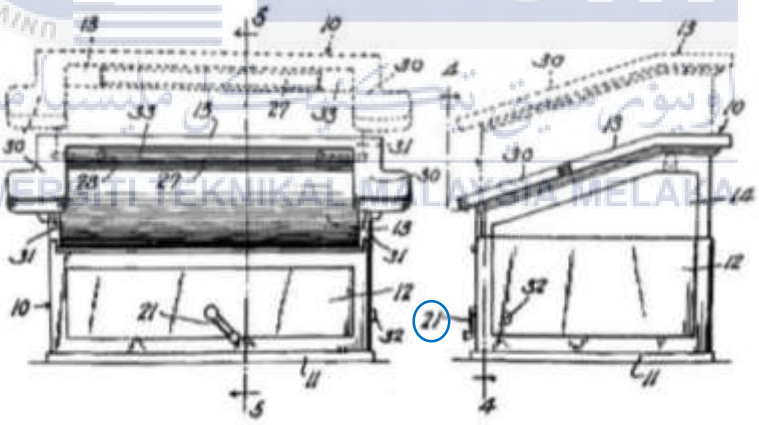


Figure 2.3: Manual vertically adjustable lectern

The longitudinal shaft, numbered 18 in the patent, has two part of worm gears that direct rotational motion to two separated transvers shaft (23) at their worm gears location (Figure 2.4).

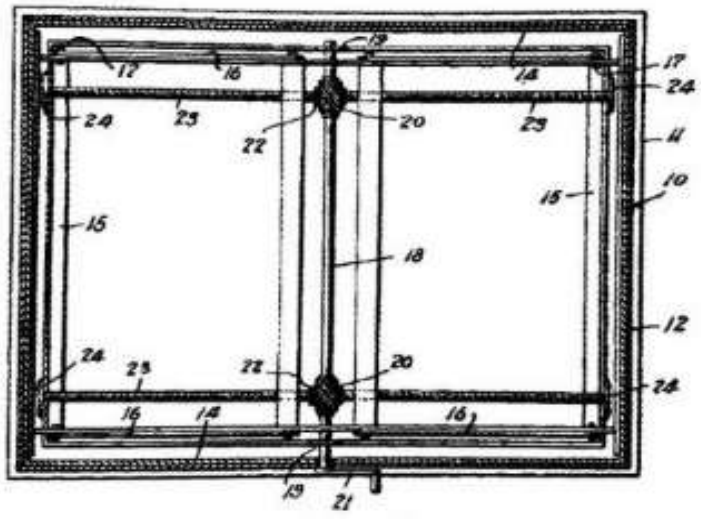


Figure 2.4: Longitudinal shafts with segments of worm gear

The transverse shafts (23) every have linkages (16 & 17) that assist the vertically extendable aspect partitions which preserve the Table pinnacle. As the longitudinal shafts is circled through the handle (21), the desk pinnacle might be actions upwardly or downwardly relying on the route of rotation (Figure 2.5). Therefore, the lectern can be adjusted o the preferred height through the speaker. This lectern layout also consists of a analysing lamp to provide visual aid to the speaker.

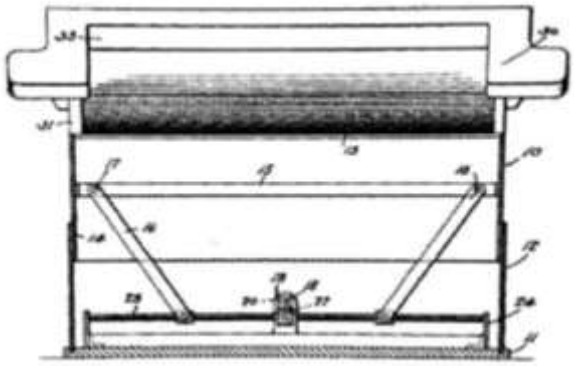
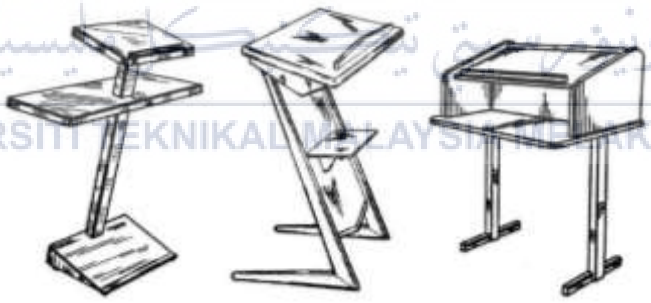


Figure 2.5: Upward and Downward position of the rostrum

Wooden made lectern designs also are quite common inside the markers because it easier and less complicated to manufacture. Many timber lectern designs had been patented in the ultimate three many years [7]. This might be because wood lecterns have better traditional capabilities and bring a feel of durability. There lecterns designs can be used as the basis for the records and further development purposes consisting of a structural layout and dimensions. A number of the wooden lectern designs are shown in Figure 2.6. The slanted wooden lectern proven in Figure 2.6 (i) was layout is this sort of way that the speaker ought to ergonomically vicinity the notes or books that had been of hobby at the lower stage and switch them to the desk top while required. This design indicates how the fashion designer tried to cope with the growing need for area to area documents during lectures and speeches. The collapsible lectern designed via George N. Glebe (1995) proven in Figure 2.6 (ii) has a skinny frame shape that slants backwards with a large computer. This layout has a hidden decrease shelf that can be used to preserve miscellaneous objects. The layout from Glebe suggests the lectern shape without the collapsible mechanisms or components.



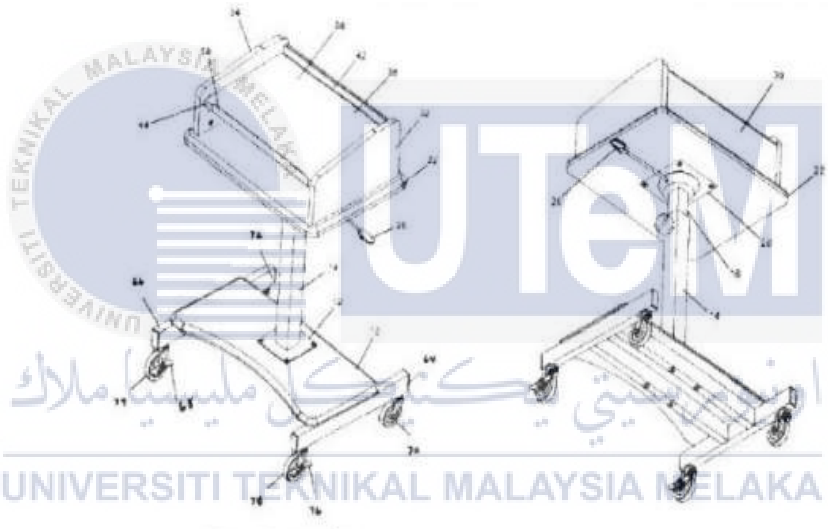
(i) (ii) (iii)

Figure 2.6: Wooden Lecterns

In addition, David L. Baron Verulam has designed a multi-purpose lectern shown in Figure 2.6 (iii) with a desk-like compartment that stands on legs. It has a multi-reason design for the reason that Table-like compartment can save various vital

documents or gadgets used for lectures or speeches [1]. The allocation and want for area is once more demonstrates in this design.

Later in 2005, a non-swiveling pneumatic lectern became introduced to deal with the numerous functions that a traditional wooden layout lectern lacks. The non-swiveling pneumatic lectern has a pneumatic cylinder disposed inside the column for vertical peak adjustment and a locking knob to lock the tube at a chosen top (Figure 2.7)



Front Perspective Bottom Perspective

Figure 2.7: Non-swiveling pneumatic lectern at front and bottom perspective

Traditional lectern are normally usual from wooden as a stable piece of fixtures capable of standing by means of itself, but the shape is big and bulky. The bulk and size of the lectern is tough to keep and the stable shape makes disassembling impossible. The designer of the non-swiveling pneumatic cylinder addressed the wishes of flexibility and garage [8]. The clothier cited collapsible lecterns have portability but lacks the power and rigidity necessary to hold heavy gadgets. Therefore,

a lightweight layout lectern is with a pneumatic cylinder at the column for top adjustment that has the rigidity and electricity of a permanent lectern and portability of a collapsible lectern. The complete frame additives are crafted from plastic except the pneumatic cylinder to attain the favored weight.

Extra complex and modern lectern's layout with voice amplification and laptop-pleasant changed into first added in 2006, designed by way of Michael J. Mastalir et al. In step with the inventors, previous art lectern have vast shortcomings while the speaker uses digital gadgets any such laptop for assistance is speech or presentation [8]. While prior artwork lecterns can also offer the surface t aid such gadgets, these lecterns don't have any provisions for accommodating wires or cables related to these gadgets resulting in such wires r cables trailing off the floor and down the perimeters or lower back of the lectern. Therefore, this lectern is designed to have top adjustable functions and is able to facilitate uses of a laptop (Figure 2.8). The peak adjustable characteristic makes use of the lead screw mechanism which can be routinely actuated with the aid of a manage device that is disposed at the aid member for easy actuation by using man or woman usage. The pc may be positioned in a cavity whilst the slide able Table pinnacle panels are slide outward and can be related to the lectern (Figure 2.9).

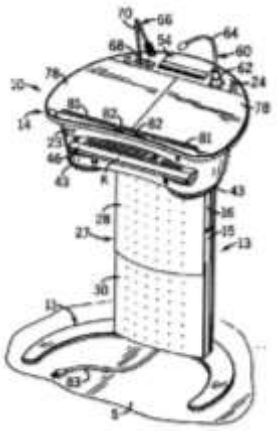


Figure 2.8: Modern lectern

Power cords and communique cables on the lectern can be connected to the laptop for power transmission and enable display on an auxiliary show device which include a projector [9]. Besides that, the layout also incorporates a simply to be had keyboard for records input functions, a neighbourhood region community (LAN) cord for interconnection with a community, a flexible stem microphone for voice amplification, a bendy stem reading lamp established on the higher wall or even retractable drink holders to assist beverage field, keys, laser pointer and others.

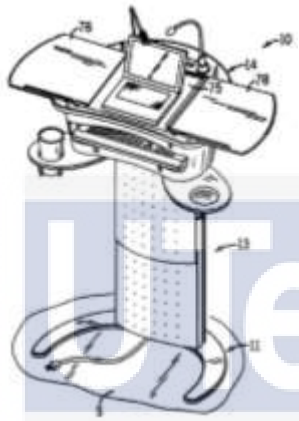


Figure 2.9: Display of different functions of the modern lectern

As a way to deal with special user body statures, Atles et al. have patented in 2008 a lectern that comprises the disable. The desk top of the lectern is each vertically and horizontally adjustable so that customers who are standing even as turning in the presentation and users who're sitting in a wheel chair can each be accommodate. The layout additionally enables popular digital gadgets requirements which includes laptops or contact screens with different primary current lectern functions along with voice amplification, keyboards and others, [9][10].

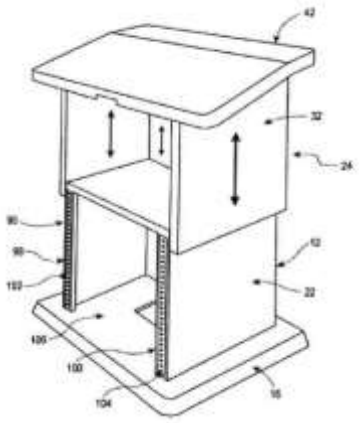


Figure 2.10: Lectern suitable for disable in wheelchair

The peak mechanism is controlled through an electrical motor with rotatable pressure screw facilitated by way of a bearing structure with the intention to easily guide the upward and downward motion of the higher column as visible in Figure 2.10. The work platform or the desk top is movable horizontally along the front to rear axis toward the speaker which permits the pinnacle to be horizontally prolonged to a wheelchair user for the compliance to large requirements. That is visualized in the Figure 2.11

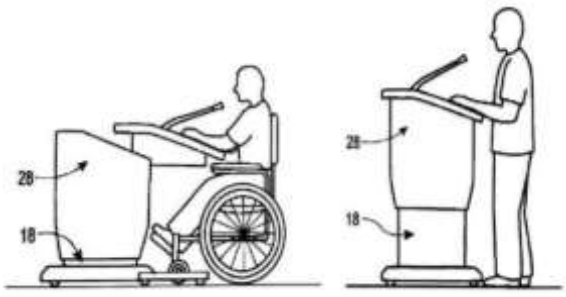


Figure 2.11: Height mechanism and movable desk top of the design for different users

Presently, enterprise in Netherlands, shrewd Lectern, is manufacturing lectern with all of the cutting-edge lectern capabilities with additions of contact displays technology in their products. The peak adjustment of the lectern is in compliance with the incapacity requirements. The display can be adjusted to tilt at three specific angles with a non-obligatory choice to have a laptop established to the lectern itself [7][9]. The agency claims that their lectern improves the retention of shows and presents green coaching enjoy. One of the coaching lectern fashions is ILS12X which have the capabilities illustrated in Figure 2.12. The agency also presents interactive contact display screen software program to allow the go with the flow of presentation to run smoothly to carry the speaker's speech and thoughts.

Figure 2.12: Modern Lectern with touch screen technology

2.4 Transmission Mechanism

Within the design factor of view, mechanisms of strength transmission are very important to construct the requirement characteristic of a device. The creative process of analysing on whether or not to apply a ball group, or tools train or a linkage or some other varieties of strength transmission which might be appropriate for the every design of the peak mechanism could be layout in this phase. The real design of every

of the strength transmission components include belts, chains gears, shafts, clutches, brakes, energy screw, ratchet structures and others.

2.4.1 Lead Screw

Lead screw, additionally known as energy screw or translation screw, is a screw used as a linkage in a tool, to translate turning movement into linear movement (Figure 2.13). Because of the large region of sliding contact amongst their male and female contributors, screw threads have huge frictional energy losses in contrast to different linkages [11]. They're no longer usually used to maintain excessive power, but extra for intermittent use in low energy actuator and positioner mechanisms. Not unusual packages are linear actuators, device slides (inclusive of in machine tools), vises, presses, and jacks.

Figure 2.13: Lead Screw mechanism

Lead screws are synthetic inside the equal manner as different thread forms. A lead screw is from time to time used with a break up nut additionally known as half of nut which lets in the nut to be disengaged from the threads and moved axially, independently of the screw's rotation, while wished.

2.4.2 Ball Screw

A ball screw is a mechanical straight actuator that translates rotational development to direct movement with little rubbing. A strung shaft gives a helical raceway to metal rollers which go about as an exactness screw. Notwithstanding being equipped for take after or oppose high push hundreds, they can do as such with insignificant inward rubbing. They're made to close re silences and are consequently reasonable for use in circumstances wherein high exactness is crucial [11]. The ball meeting acts on the grounds that the nut in the meantime as the strung shaft is the fastest as Figure 2.14. In contrast with traditional lead screws, ball screws have a tendency to be as an option cumbersome, because of the need a system to re-flow the balls.

Figure 2.14: Design of Ball Screw

Some other type of direct actuator construct absolutely with respect to a pivoting pole is the string less ball screw. In this format, 3 (or additional) moving ring course are sorted out symmetrically in a lodging encompassing simple (string less) actuator pole or shaft. The direction are set at a state of mind to the pole, and this point of view decides the course and rate of straight movement as indicated by unrest of the pole

[11][12]. A reward of this design over the ordinary ball screw is the reasonable evacuation of backfire and stacking caused by preload nuts.

2.4.3 Transmission Mechanism Parameters Consideration

The selection of lead and screw ball in a certain system depends at the wishes and the required parameter which ought to be placed into consideration in designing steps. The cause of the mechanism is to offer long term linear movement translated from rotation movement with the favored work parameters.

2.4.3.1 Load

The burden is the weight experienced via the screw. For vertical application along with lifting and jacking the burden equals the load of the load being moved. For horizontal application the weight equals the burden of the load instances the coefficient of friction of the supporting media.

2.4.3.2 Back power

Whilst a ball screw or lead screw is compelled to transport linearly alongside the shaft by way of an applied force or gravity in vertical orientation, it pressure or again-drives the shaft for that reason making it rotates. Ball screw assemblies in

vertical orientations may additionally again-power their shafts, if their performance is high and initial begin-up friction value is low.

2.4.3.3 Driving Torque

The driving torque (T_d) is the force required to rotate the screw and to move the load and it is defined as follow:

$$T_d = \frac{PL}{2\pi e} \quad (2.1)$$

T_d = Driving torque (Newton. meter)

P = Load (Newton)

L = Lead of screw (meter/revolution)

e = Ball bearing screw efficiency (approximately 0.9 for ball screw, 0.4 for acme screw with plastic nuts, and 0.25 for acme screw with bronze nuts)

2.4.3.4 Accuracy

Backlash problems need to be taken into consideration in packages that require precision positioning in both guidelines. Besides that, accuracy as opposed to time degradation because of screw wear and ball bearing fatigue is especially vital in unique positioning device that does not have closed-loop comments controls. Ball screw have

longer term accuracy because the useful lifestyles of the ball screw determined with the aid of steel fatigue instead of everyday put on traits of a traditional screw[11]. The ball bearing of a screw skilled minimal dimensional changes over the lifestyles of a ball screw, thus casting off the want for common compensation adjustments.

2.4.3.5 Lead

Lead refers to distance the nut travels with one rotation of the screw. Lead determines the full rotational needed to reap the preferred linear motion inside the software of the lead screw or ball screw. Large lead method lower precisions while smaller lead manner better precisions. The trade-off among the lead parameter is pace and precision. While fast journey is needed, layout for screws with excessive lead to reduce the shaft speed to avoid rotational and vibrational facet outcomes.

2.4.3.6 Life

The advocated operating loads of the ball screw assemblies are based totally on a expected existence of travel distance, providing the meeting is lubricated. The cycle life of the mechanism is determined via the level of utilization, surrounding environment and proper maintenance. Determining the cycle lifestyles is crucial to alleviate any issues thru right protection and alternative.

2.4.3.7 Backlash

Backlash, give up play, position inaccuracy or loss of motion between the nut and the screw can be removed by means of preloaded the nut assembly. Backlash in ball screw are countered with preloading the assembly while in lead screw backlash are removed with anti-backlash mechanism.

2.4.3.8 Wipers

Brush kind wipers maximizes ball screw performance spreading lubricant over the length of the screw and preventing inner ball nut contamination from foreign cloth. Bellows and telescopic wipers are appropriate for dirty environments which require the least upkeep.

2.4.4 Lead screw vs. Ball screw

Table 2.1 compares the lead screw and the ball screw characteristics in various aspects.

Table 2.1: Comparison between lead screw and ball screw

Technology	**Lead Screw**	**Ball Screw**
Movement	Rotary to linear	Rotary to linear
Torque Requirement	Higher	Lower
Cost	Initial lower cost	Expensive
Noise Level	Lower	Higher
Efficiency	Low	Near to full efficiency
Load Carry Capacity	Low	High
Accuracy	Low	High
Precision	Normal	Good
Life Span	Shorter	Longer
Backlash	Can be eliminated with anti-backlash assembly	Can be eliminated with preloading

In short, lead screw are used in software that calls for much less precision with low value attention. However, ball screws may be carried out for method that calls for high repeatability with much less error and less protection however at a comparatively higher cost. The blessings of every mechanism will be weight to the attention of the function in the design.

2.4.5 Gears

Gear or cogwheel is a turning device segment having lessen teeth, or machine gear-pieces, which work with some other toothed part to transmit torque as shown in Figure 2.15. Equipped gadgets can trade the speed, torque, and course of a vitality supply. Apparatuses about dependably create an exchange torque, growing a mechanical preferred standpoint, by means of their devices proportion, and subsequently might be thought about a straightforward contraption. The veneer on the 2 fitting riggings all have a similar shape. Two or additional cross section gears, working in an arrangement, are alluded to as an apparatuses instruct or a transmission. A rigging can work with a straight toothed component, known as a rack, accordingly delivering interpretation rather than turn [7].

Figure 2.15: Gear meshing

The gear in a transmission are undifferentiated from the wheels in a crossed, belt pulley framework. Preference of apparatuses is that the teeth of a gear counteract slippage. At the point when two apparatuses work, on the off chance that one gear is greater than the other, a mechanical preferred standpoint is delivered, with the rotational paces, and the torques, of the two gears varying in extent to their diameters[13][7]. Two or more gears cooperating can create a mechanical favorable position through a gear proportion. The estimation of the gear proportion is as below.

$$Gear\ Ratio = \frac{Angular\ velocity\ A}{Angular\ velocity\ B} = \frac{number\ of\ teeth\ in\ B}{number\ of\ teeth\ in\ A} = \frac{diameter\ B}{diameter\ A} \quad (2.2)$$

$$Gear\ Ratio = \frac{W(A)}{W(B)} = \frac{n(B)}{n(A)} = \frac{d(B)}{d(A)} \quad (2.3)$$

With A being the driving gear and B being the driven gear. Usually, if pace is wanted a low equipment ratio is required and if torque is desired then excessive equipment ratio is essential. The ratio between the gear gives manage of the velocity and torque of the output shaft [13][14]. A equipment ratio is truly the relationship among the range of rotations the power shaft turns to complete one full flip of the other or vice versa. As an example, the calculation of the tools ratio the tools educate (Figure 2.16) is as following.

$$Gear\ Ratio = \frac{W(A)}{W(C)} = \frac{W(A)}{W(B)} \times \frac{W(B)}{W(C)} \quad (2.4)$$

The gear operating collectively in organization of or extra are known as a equipment teach. The gears in among riding gear and driven tools in a gear train are referred to as idlers. Figure 2.16 suggests equipment inside the centre because the idler. Tools may be meshed in lots of exceptional methods to obtain the favored speed, route, motion and torque.

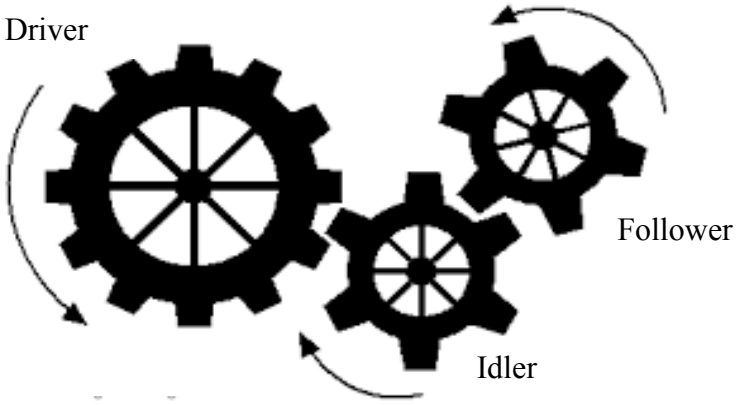
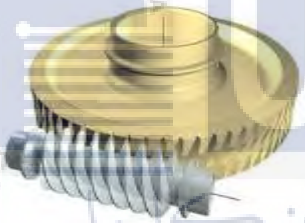


Figure 2.16: Gear train of three gears

There exist different types of gear for the mechanical design and each of them has its own advantages and disadvantages. In brief, Table 2.2 summarizes comparison among several type of gear.

Table 2.2: Basic gear types comparison

Gear type	Illustration	Description
Spur Gear		- Transmitting motion between two parallel shafts - Easy to find and inexpensive - Efficient - Not suitable Table for direction change purpose
Bevel Gear		- Direction of a shaft needs to be change. - Transmit motion where the bevel gear shafts are at right angle (90˚) to each other
Worm Gear		- Speed reducer and change direction. - The gear with one tooth is called worm whereas the helical gear is called worm wheel. - Worm always drives worm wheel and never be other way around. - Quiet running
Rack and pinion		- Convert rotational to linear motion. - Backlash can be eliminated with dual pinions. - Used in steering mechanism
Internal Gear		- Better load-carrying capacity. - Teeth are guarded

Tools are created from numerous fabric. Plastic tools are made from materials such as polycarbonates, Bakelite and polyamide and are suitable table for low power

and pace cause. Gears with high power and torsional homes require low-carburize metal bronze or chrome steel substances for gears with the houses.

2.4.6 Belt

A belt is a circle of adaptable material used to connect two or additional pivoting shafts consequently, most generally parallel. Belts might be utilized as a supply of movement, to transmit control adequately, or to track relative development. Belts are circled over pulleys and can have a control among the pulleys, and the poles need not be parallel. In a two pulley gadget, the belt can either drive the pulleys by and large one way, or the belt can be crossed, all together that the course of the determined shaft is turned around. As a wellspring of movement, a transport line is one application in which the belt is custom fitted to hold a heap continually between two factors [14][15].

2.4.6.1 V-Belt driver

Belt drives are one of the most punctual vitality transmission frameworks and were generally utilized amid the business Revolution. At that point, level belts passed on control over expansive separations and have been made from calfskin. Afterward, requirements for all the more effective hardware, and the development of vast markets which incorporate the car endeavor impelled new belt plans. V-belts (Figure 2.17), with a trapezoidal or V shape, produced using elastic, neoprene, and urethane engineered materials, changed level belts. Presently, the duplicated general surface material of contemporary belts holds fast to pulley grooves through rubbing power, to decrease the strain required to transmit torque [14][15]. The zenith part of the belt, called the strain or protection portion, conveys fiber ropes for enhanced power as it conveys the heap of footing weight. It empowers hold nervousness members in region and goes about as a fastener for additional grip among lines and distinctive areas. On

this way, warmness develop up is diminished, broadening belt ways of life. Pre extended uneasiness part lines (polyester, aramide, metal, fiber glass) likewise confine extend.

Figure 2.17 Multi V-belt Drive

The most reduced, or pressure section, is intended to look up to pressure. It's miles made from a hard elastic intensify that applies a wedging weight against the pulley section to blast adherence without twisting. The defensive cover (usually a versatile cowl result of elastic impregnated texture that is slip-safe and strong) is a warmness-safe layer that ensures the belt's inner segments.

2.4.6.2 Toothed Belt drive

Toothed belt or all the more generally alluded to as timing belt, is a piece of an inward burning motor that synchronizes the revolution of the crankshaft and the camshaft(s) with the goal that the motor's valves open and close at the correct circumstances all through each chamber's utilization and fumes strokes [14]. In an obstruction motor the planning belt or anchor is moreover urgent to keeping the

cylinder from hanging the valves. A planning belt is regularly a toothed belt (Figure 2.18), a drive belt with teeth at the interior floor. A planning chain is a styler chain.

Figure 2.18: Toothed belt Drive

Most present day creation car motors utilize a planning belt or fasten to synchronize crankshaft and camshaft revolution; a few motors as a substitute utilize apparatuses to immediately drive the camshafts. the utilization of a planning belt or affix in inclination to guide gear weight empowers motor fashioners to area the camshaft(s) likewise from the crankshaft, and in motors with two or three camshafts a planning belt or chain furthermore empowers the camshafts to be put also from each extraordinary.

Timing chains have been regular on assembling cars by means of the Nineteen Eighties, while timing belts turned into the standard, however timing chains have seen a resurgence as of late. Timing chains are normally additional dependable than timing belts, despite the fact that nor is as solid as immediate instruments weight, notwithstanding, timing belts are lighter, less extravagant, and perform additional discreetly.

2.4.7 Chain Drives

Chain control (Figure 2.19) is a way of transmitting mechanical vitality from one territory to some other. It is regularly used to convey quality to the wheels of vehicle, particularly bikes and bikes. It is likewise used in a gigantic type of machines other than autos.

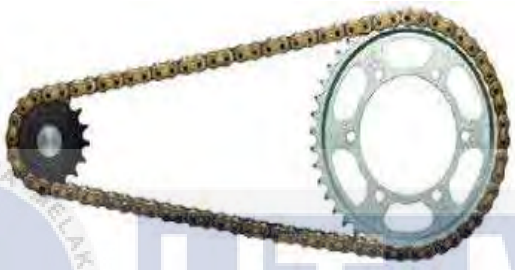


Figure 2.19: The Chain Drive

Frequently, the vitality is passed on by methods for a styler chain, known as the drive chain or transmission chain, disregarding a sprocket apparatuses, with the lacquer of the devices fitting with the gaps inside the connections of the chain [12]. The apparatuses is developed to wind up, and this pulls the chain putting mechanical weight into the machine. Some other type of drive chain is the Morse chain, developed through the Morse Chain association of Ithaca, New York, United States of America. This has transformed polish.

From time to time the quality is yield by utilizing just turning the chain, which might be utilized to lift or drag objects. In different circumstances, a moment adapt is situated and the power is recuperated by joining shafts or centre points to this rigging. Despite the fact that power chains are regularly basic oval circles [12], they can likewise circumvent corners by setting more prominent than gears close by the chain;

equips that don't situated quality into the machine or transmit it out are by and large known as loafer-wheels.

Through different the distance across of the information and yield gears with perceive to each unique, the devices proportion can be adjusted. For instance, while the bike pedals' rigging turn once, it reasons the hardware that drives the wheels to pivot various unrest.

2.4.8 Cams

A cam is rotating body which imparts a reciprocating or oscillatory predetermined particular movement to a 2d frame called the follower with which it is constantly touch. Abnormal shaped cam rotates in an axis positions in order that the follower movements eccentrically. The cam rotates the follower this is made to rise, live and fall. The lengths of time spent at each function rely on the shape of the cam. The motion and positioning depends on two elements which are the shape of the cam. The movement and positioning relies upon on factors which can be the form of the cam and the type of the follower. Extraordinary applications requires cam shapes that fit the capability and needed conditions. Elliptic cams (Figure 2.20(a)) provide uniform acceleration and deceleration to the follower. The coronary heart-fashioned cam (Figure 2.20(b)) provides 3 high point for every flip. The pear-fashioned cams (Figure 2.20 (c)) are used for lengthy upward push and fall motion.

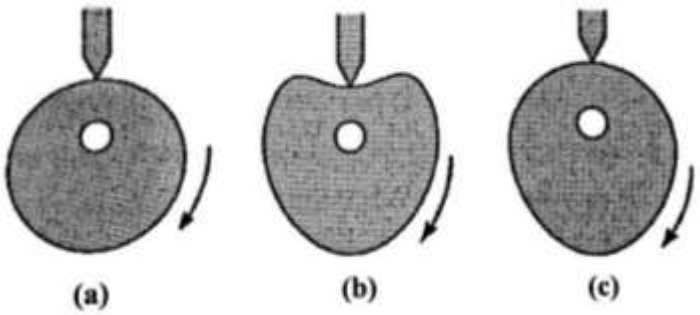


Figure 2.20: Cams: (a) elliptic, (b) heart-shaped, (c) pear-shaped

The shape d the following is of three types which are the pointed follower, roller-type follower and flat-faced follower (Figure 2.21). Pointed follower has a knifelike edge for profiling and it is the simplest compared to the others but will experience rapid wear. The roller-type follower reduce friction and wear but is more expensive. The flat-faced followers are cheap and durable and are widely used in engine valve cams

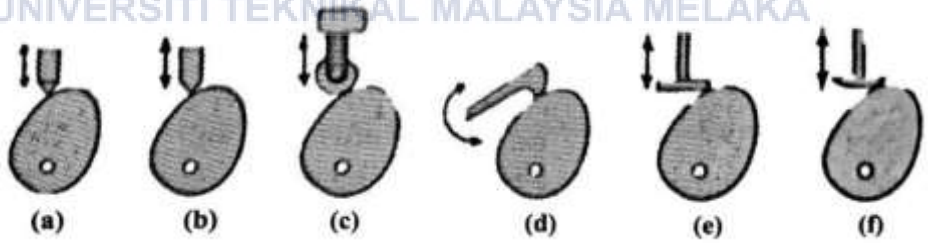


Figure 2.21: Follower (a) point, (b) knife, (c) roller, (d) sliding and oscillating, (e) flat, (f) mushroom

2.5 Sensors

A dependable, efficient and suitable detection method employed to come across the presence of s individual are important inside the layout of automatic height adjustable rostrum. Sensor or transducers will be applied to come across the presence or absent of a person approaching the rostrum. Right positioning of the sensing device will degree the peak of the individual in order that appropriate height of the podium can be actuated by way of the mechanism provide a secure surroundings for the speaker [16]. In this part, detection and sensing approach be mentioned for have a look at and analysis in later bankruptcy

Sensor within the part of the dimension system that responds to the particular bodily phenomenon or parameter to be measured. Transducer is the component for the machine that transfer statistics within the form of power from one to some other form of the opposite system [16]. The two phrases will be used interchangeably in the following elements.

2.5.1 Proximity Sensor

A proximity sensor is a sensor fit for unearth the nearness of adjacent articles with none physical touch. A closeness sensor much of the time emanates an electromagnetic train or a light emission radiation (infrared, as an example), and searches for adjustments in the territory or return flag. The protest being detected is frequently called the nearness sensor's objective. Distinctive nearness sensor targets call for extraordinary sensors. As an example, a capacitive or photoelectric sensor is most likely reasonable for a plastic focus on; an inductive closeness sensor dependably requires a metallic target.

The most extreme separation that this sensor can distinguish is depicted "ostensible territory". A couple of sensors have changes of the ostensible territory or strategy to report a graduated location separate [17]. A couple of perceive these strategies as "thermosensation". Nearness sensors may have a high unwavering quality and long practical presence as a result of the nonattendance of mechanical segments and absence of physical contact amongst sensor and the detected thing.

Nearness sensors are generally utilized on cell phones to distinguish in the event that somebody is in ostensible territory. While the objective is recognized, the gadget bolt show UI will appear to be, along these lines rising up out of what's called rest mode. Once the gadget has awoken from rest mode, if the nearness sensor's objective is still for an expanded timeframe, the sensor will then overlook it, and the gadget will in the end return into rest mode. For instance, sooner or later of a telephone call, nearness sensors assume a part in distinguishing (and skipping) coincidental touchscreen spigots when held to the ear. They're broadly used in gadget vibration checking to quantify the variation in remove among a pole and its guide bearing. This is ordinary in gigantic steam factories, compressors, and autos that utilization sleeve-type direction.

Benefits of the use of proximity sensors along with high reliability, appropriate overall performance, desirable for harsh surroundings, resist surprise and vibration, excessive refresh price allow detecting items transferring at excessive pace, and able to differentiate metal and non-metal object.

2.5.1.1 Photoelectric sensor

Photoelectric sensors are with no inconvenience introduce in normal presence [18]. They help securely control the opening and staying of capacity entryways, switch

on sink taps with the flood of a hand, control lifts, open the entryways at the basic supply keep, find the overall vehicle at hustling events, thus considerably more.

A photoelectric sensor is a gadget that identifies a change in gentle force as appeared in Figure 2.22. Typically, this demonstrates either non-identification or recognition of the sensor's radiated gentle source. The sort of mellow and strategy by method for which the objective is identified changes depending at the sensor.

Photoelectric sensors are comprised of a light source (LED), a collector (phototransistor), a flag converter, and an enhancer. The phototransistor break down approaching light, checks that it is from the LED, and accurately triggers a yield.

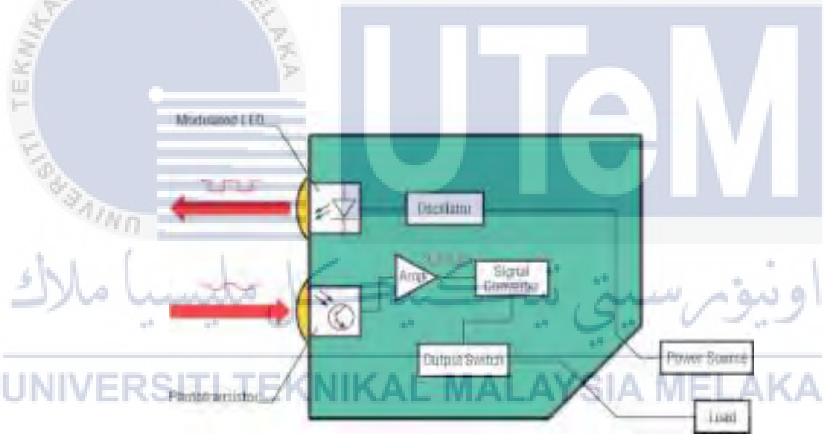


Figure 2.22 Photoelectric sensor

Photoelectric sensors give many advantages while contrasted with various advancements. Detecting levels for photoelectric sensors far outperform the inductive, capacitive, attractive, and ultrasonic advancements [18]. Their little size as opposed to detecting assortment and an exceptional kind of lodgings makes them an extremely culminate fit for any application. At some point or another, with nonstop advances in innovation, photoelectric sensors are cost aggressive with various detecting innovation. Photoelectric sensors offer three essential methods of objective location:

inconspicuous, retro-intelligent and through-bar, with forms of each. The advantages and drawbacks of those modes are in Table 2.3.

Table 2.3: Photoelectric Modes with advantages and disadvantages.

Name	Pros	Cons
Diffuse	- Can be install at a point - More cheaper than others	- Low accuracy then others - Need much setup time
Through – Beam	- High Accuracy - Wide sensing span - High Reliable	- Must introduce at two focuses on framework: producer and collector - Costly - must buy both producer and collector
Retro – Reflective	- Only marginally less exact than through-beam - Sensing range superior to diffuse - Very solid	- Less exact than through-beam or intelligent - Larger setup time included

Photoelectric sensors give three essential strategies for objective identification: diffused, retro-intelligent and through pillar, with varieties of each. The points of interest and downsides of those modes are in Table 2.3.

Diffused Mode: In diffused mode detecting, on occasion known as vicinity mode, the transmitter and recipient are in a similar lodging [19]. Mellow from the transmitter moves the objective, which shows light at self-assertive points. Some of the reflected light comes back to the recipient, and the objective is recognized. because of the reality a lot of the transmitted quality is lost due to the objectives state of mind and ability to reflect mellow, unpretentious mode impacts in shorter detecting stages than is potential with retro-intelligent and through bar modes.

Retro-reflective mode: unfashionable-intelligent mode is the second essential method of photoelectric detecting. Similarly as with inconspicuous mode detecting, the transmitter and recipient are in a similar lodging, yet a reflector is utilized to reflect the mellow from the transmitter again to the collector [19]. The objective is identified while it obstructs the pillar from the photoelectric sensor to the reflector. Unfashionable-intelligent mode ordinarily lets in longer detecting degrees than inconspicuous mode due to the raised productivity of the reflector contrasted and the reflectivity of most extreme objectives. The objective tinge and complete do now not influence the detecting range in unfashionable-intelligent mode as they do with diffused mode.

Thru-beam mode: through-pillar mode moreover alluded to as ill-disposed mode is the 1/3 and last essential procedure of recognition for photoelectric sensors. This mode utilizes isolate lodgings, one for the transmitter and one for the collector. The gentle from the transmitter is gone for the beneficiary and keeping in mind that an objective breaks this mellow bar, the yield on the collector is actuated [19]. This mode is the most extreme green of the three, and lets in the longest practical detecting levels for photoelectric sensors.

2.5.1.2 Capacitive Proximity sensor

Capacitive detecting is a noncontact period appropriate for recognizing metals, non-metals solids, and beverages, in spite of the fact that it is fine material for non-metallic targets due to its characteristics and value in respect to inductive nearness sensors. In most extreme bundles with steel objectives, inductive detecting is supported because of the reality it's far each a tried and true and a more noteworthy reasonable age.

Figure 2.23: Capacitive Proximity sensor

Inside the sensor is a circuit that uses the gave DC quality to produce AC, to gauge the present day inside the inward AC circuit, and to trade the yield circuit when the amount of AC introduce day adjustments. Dissimilar to the inductive sensor, in any case, the AC does now not drive a curl, yet rather endeavors to charge a capacitor. Comprehend that capacitors can keep an expense in light of the fact that, while one plate is charged unquestionably, terrible costs are pulled in into the other plate, as a result permitting significantly more noteworthy superb expenses to be brought into the principal plate [8][19]. Until the point when the two plates are available and near each extraordinary, it is exceptionally hard to reason both plate to go up against extremely a dreadful part charge. Best one of the required two capacitor plates is undoubtedly developed into the capacitive sensor. The AC can flow current into and out of this plate handiest if there might be another plate adjacent which could keep the other cost.

The objective being detected goes about as the contrary plate. In the event that this thing is close adequate to the substance of the capacitive sensor to be disappeared with the charge inside the sensor's inward capacitor plate, it'll react through transforming into oppositely charged near the sensor, and the sensor will then be equipped for move full-measure present day into and out of its interior plate [8].

2.5.1.3 Ultrasonic Proximity Sensor

Ultrasonic proximity sensors utilize reflected or transmitted ultrasonic waves to go over the nearness or nonattendance of an objective issue. The yield is boolean, that is, the sensor only identifies regardless of whether the objective is or isn't generally inside the identification run. Ultrasonic closeness sensors produce and get sound waves. The bearer flag is an over the top recurrence, imperceptible sound wave [2]. They find the nearness of the objective thing in one among designs.

Diffuse or Reflective sensors have the transmitter and recipient bundled in the indistinguishable lodging. While an objective enters the detecting scope of the device, the ultrasonic waves are reflected again to the sensor (Figure 2.24). Opposing or through-Beam sensors have the transmitter and recipient bundled independently. The recipient is mounted confronting the transmitter and while a thing enters the detecting assortment of a restricted sensor, it hinders the transmitted flag [2]. Instead of actuating the reason while the recurrence is gotten, the reason is enacted while the sign is harmed.

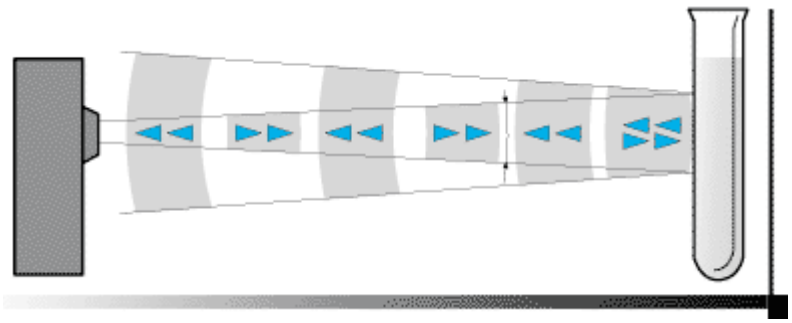


Figure 2.24: Ultrasonic sensor and its reflecting wave

Ultrasonic proximity sensors can distinguish a spread of items regardless of its material or surface properties. They might be useful for protest recognition over transitional separations, on the request of a few feet. At close vicinity they claim a blind side wherein objects are not recognized. They can likewise perform in a wide assortment of running circumstances. While searching for ultrasonic vicinity sensors, detecting general execution, supplier sign and switch execution are the most basic parameters to remember.

Detecting general execution: particulars for detecting execution comprise of running separation and repeatability. Evaluated working separation is the essential separation at which exchanging takes area. It's far fundamental to choose a sensor a decent approach to work inside the required detecting range. This could be managed by methods for strategy necessities and mounting decision. Repeatability is the space inside which the sensor repeatable switches. It is a level of accuracy. Depending at the application, exactness might be a basic plan rule while choosing a sensor.

Bearer flag: specs portraying a sensor's transporter sign comprise of visually impaired quarter and transmitter recurrence. The visually impaired part is the space reaching out from the substance of the sensor in which no things might be identified [2]. The visually impaired zone is equivalent to half of the wavelength of the ultrasonic wave. The transmitter recurrence is the assortment of wide-threw and got cautions, measured in hertz or waves with regards to second.

Electrical Switch Performance: Depending on the power choices accessible, control needs might be a key determination while choosing a sensor. The gadget can be fueled by either an AC or DC control source. Load designs are required parameters to consider. Ultrasonic nearness sensors may switch an AC stack or a DC stack. DC stack setups can be NPN or PNP. NPN is a transistor yield that switches the normal or less voltage to the heap; stack associated between sensor yield and positive voltage

supply [2]. PNP is a transistor yield that switches the positive voltage to the heap; stack associated between sensor yield and voltage supply ordinary or negative.

2.5.1.4 Inductive Proximity sensor

Inductive proximity sensor are maximum the normally employed industrial sensor for detection of ferrous and non-ferrous object (Figure 2.25). Due to the truth that inductive sensors can feel non-metal materials, those sensors can be lined, potted and sealed which permit operation in grimy or contaminated work areas or maybe submerged in fluids.

Figure 2.25: Illustration of inductive sensor by a sensor company

Inductive proximity sensors generate an oscillatory radio frequency subject (100kHz to 1MHz) around a coil of wire commonly wound round a ferrite middle, as the metallic goal tactics the sensor face, the oscillator output voltage falls off, eventually losing underneath a presser cause level, whereupon the threshold comparator toggles from an off nation to an on nation. Increasing the distance reasons the voltage to rise and the output switches off as the release level is exceeded [16].

Inductive proximity sensors are differentiated into two basic type that are; shielded and unshielded (Figure 2.26). Unshielded inductive sensors are without problems affected by nearby metals ensuing difficulties in sensing but shielded inductive sensor do now not skilled this problem due to focusing of the sphere to the front which prevents lateral detection. Therefore unshielded inductive sensors must be hooked up on non-metal surfaces only.

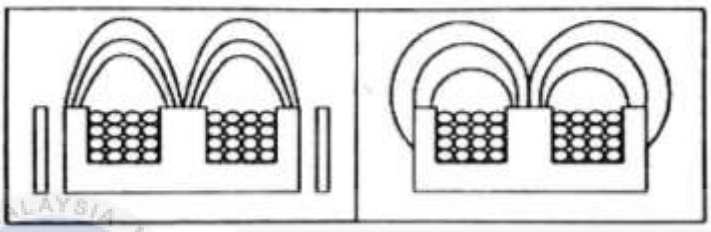


Figure 2.26: Shielded inductive sensor (left) and unshielded inductive sensor (right)

2.5.2 Vision System

The fundamental configuration of a imaginative and prescient system is proven on Figure 2.27. Digital camera is used to seize a photo which is then converted for garage inside the body grabber or a video capture card. Facts from the body grabber can then be processed by using the computer and after undergoing positive algorithms, a appropriate output can be generated [20]. The outputs of the systems may be a robotic arm or a actuation mechanism or the records can be saved for high-quality control purposes.

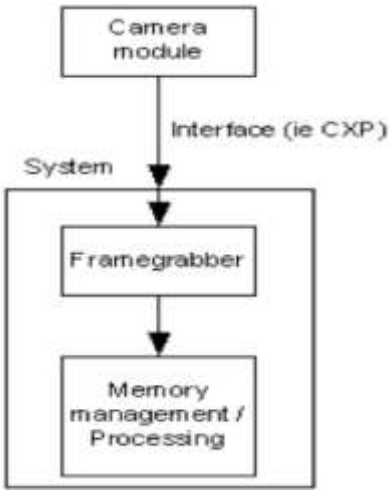


Figure 2.27: Basic vision system

In vision systems the primary thing is the digital camera which has different sorts which include RS-a hundred and seventy/CCIR monochrome, NTSC/friend shade, progressive test, variable test or line test. The five primary factors which govern the choice of camera are subject of view, decision, running distance, depth of field and picture records acquisition fee. Coloration can be an vital aspect, if coloration imaging is wanted for the utility. The video capture card or the body grabber interfaces with the digital camera and the laptop and its responsibility is to shop the image data from the digital cam in on-board or machine memory for sampling and digitizing the analogue statistics. Pixel from the frame grabber are analysed through the processor using a positive software within the computer. When the photo had been analysed the machine have to be able to communicate the result to govern the procedure or the bypass facts to a database.

In line with Jason Schlessman et al. (2006), imaginative and prescient gadget used for human detection of their observe is permit powered, low fee and wi-fi digital cam sensor. The digital camera sensor is ready into conditions which might be stationary and mobile. In both situation, whilst an object is efficaciously detected with the aid of a proximity sensor, the digital cam will activate to capture the nearby

photographs [21]. Pixel are received wirelessly by using a host node along with a laptop for energy consuming challenge including image processing and face detection approaches. The low powered strategy is performed via using digital camera with decreased energy sleep mode and an structure that sends compressed captures images which lessen transmission power and time. Their paintings utilizes business off-the-shelf components to construct the device that's fairly inexpensive that serve the low fee aim. This system may be beneficial for machine such as intrusion detection, pedestrian detection for vehicle and lost infant locating.

2.5.3 Face Detection system

A face fame gadget is a PC application ready to distinguishing or checking a man from a computerized photograph or a video outline from a video source. One of the approaches to do that is by methods for assessing settled on facial capacities from the photo and a face insights base. It's far ordinarily utilized as a part of security structures and can be when contrasted with various biometrics including unique mark or eye iris ubiquity structures [20]. Nowadays, it has likewise develop to be famous as a business personality and showcasing apparatus.

A couple of face acknowledgment calculations choose facial abilities through extricating points of interest, or capacities, from a photograph of the issue's face. For example, a calculation may analyse the relative part, length, and additionally state of the eyes, nose, cheekbones, and jaw. Those abilities are then used to search for various depictions with coordinating capacities [22]. Diverse calculations standardize a display of face pics and after that pack the face data, best sparing the measurements in the photo this is valuable for confront prevalence. A test photo is then contrasted and the face information. One of the most punctual a win frameworks is fundamentally in

light of layout coordinating methods (Figure 2.28) did to an arrangement of striking facial capacities, introducing a sort of compacted confront outline.

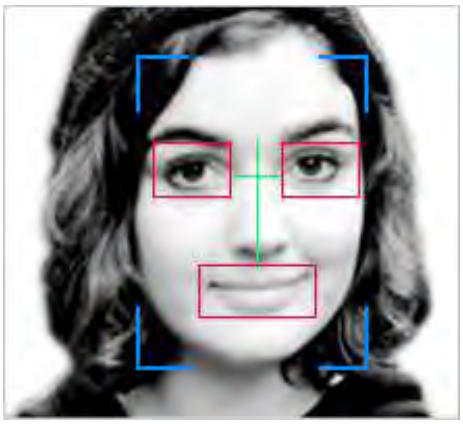


Figure 2.28: Face detection using Template matching

Notoriety calculations can be isolated into two noteworthy techniques, geometric, which shows up at recognizing capacities, or photometric, that is a factual approach that distils picture into qualities and contrasts the qualities and layouts to evacuate fluctuations.

Fortunately, faces have a few easily recognisable features that cameras can lock directly to; a couple of eyes, nostril, and a mouth. By using being capable of come across a face within the scene, the camera can concentrate its autofocus on that individual's face to make sure it's far the primary subject in awareness in the image [20]. Extra state-of-the-art implementations also can hyperlink as much as scene-popularity algorithms and optimise the exposure for the difficulty's face.

Once a face has been detected, the device will music that face as excellent it may. If the person turns away, detection lock could be misplaced, even though a few

digital camera manufacturers have enhanced the detection functionality to maintain a lock even when the difficulty has grew to become to the quantity that handiest one eye remains visible [23][24].

A few face detection modes can lock onto several faces right now, in which case the face this is used because the number one problem of focus will generally be based on that's closest or maximum prominent, even though now and again you can override this with the aid of selecting a face manually. If numerous faces are detected right away, not they all will always be in consciousness.

2.6 Height Adjustment Mechanism

Height adjustment mechanism is the mechanism which used to control or adjust the height of the rostrum.

2.6.1 Power windows

Energy home windows are used in vehicle to raise and lower the window by means of pushing on a button or switch. The window carry of automobiles utilizes a linkage to boost the window while preserving it stage [25]. A small electric motor is attached to a computer virus gear and different spur gears to create a huge equipment ratio, giving enough torque to raise the window [26].

The benefit of worm equipment inside the motive force mechanism is the electricity window cannot be pressured to open because of the self-locking feature

whilst the trojan horse and the equipment are in touch at certain attitude [27]. In other words, the trojan horse can spin the equipment, but the gear cannot spin the computer virus.

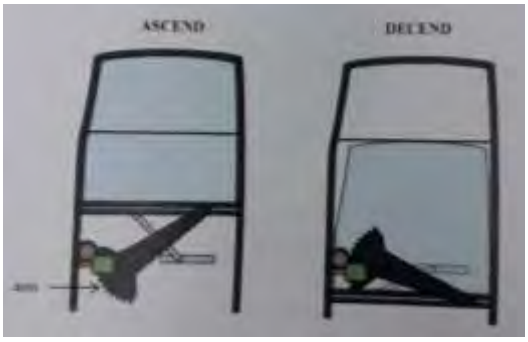


Figure 2.29: window lifting mechanism

The linkage has along arm which attaches to a bar that holds the lowest of the window (Figure 2.29). The stop of the arm can slide alongside the groove inside the bar as the window rises and on the alternative cease of the bar, there's a large plate that has tools teeth reduce into it, wherein the motor turns a tools that engages those tooth [25]. The window rises and descends depending at the course of the rotation of motor.

2.6.2 Aerial work Platform

An aerial paintings platform or extended work platform is a mechanical tool that ascends and descends to provide humans brief get admission to inaccessible high places [28]. There are two kind of mechanized aerial platform, the ‘cherry picker’ and the ‘scissor lift’. The cherry picker operates the usage of hydraulic pistons or electrical

electricity for the height mechanism and is mainly use for window cleansing operation and maintenance paintings (Figure 2.30).

Figure 2.30: Cherry Picker

The scissor existence is an aerial platform that movements vertically with a mechanism of folding supports in a criss-move X pattern (Figure 2.31). The upward movement is accomplished by way of making use of movement to the lower set of aid to elongate the crossing pattern and consequently propelling the work platform vertically [28]. The scissor carry can be powered with hydraulic, pneumatic or lead screw mechanism.

Figure 2.31: Scissor lift illustration

2.7 Controller

A controller, in a registering setting, is an equipment gadget or a product programming that oversees or coordinates the float along with measurements among substances. In processing, controllers might be cards, microchips or separate equipment contraptions for oversee of a fringe gadget. In a general affair, a controller can be idea of as something or a man that interfaces between two structures and oversees correspondences among them.

2.7.1 Arduino

Arduino is an open source pc equipment and programming organization, assignment, and client group that plans and makes unmarried-board microcontrollers and microcontroller packs for developing virtual gadgets and intuitive articles that could detect and control contraptions inside the physical universal [24]. The endeavor's stock are disseminated as open-source equipment and programming program, which are authorized beneath the GNU Lesser standard Public License (LGPL) or the GNU popular Public License (GPL), permitting the make of Arduino gatherings (Figure 2.32) and programming program appropriation with the guide of completely everybody. Arduino sheets are accessible economically fit as a fiddle, or as do-it-your self (DIY) bundle [21].

Figure 2.32: Arduino (UNO) controller

Arduino board plans utilize a consequence of chip and controllers. The discussions are outfitted with sets of advanced and simple info/yield (I/O) sticks that might be interfaced to different development gatherings (shields) and different circuits. The gatherings trademark serial correspondences interfaces, alongside consistently happening Serial Bus (USB) on a few styles, which may be additionally utilized for stacking bundles from non-open PCs [23]. The microcontrollers are ordinarily customized the utilization of a vernacular of highlights from the programming dialects C and C++. Notwithstanding the utilization of customary compiler gadget chains, the Arduino mission offers an included change condition (IDE) in view of the Processing dialect challenge.

The Arduino wander began in 2003 as an application for school kids on the exchange format Institute Ivrea in Ivrea, Italy, meaning to give a minimal effort and simple path for fledglings and experts to make gadgets that draw in with their condition the utilization of sensors and actuators. Typical cases of such gadgets proposed for amateur specialists incorporate basic robots, indoor regulators, and development locators.

2.7.2 Raspberry Pi

A Raspberry Pi is a Visa estimated workstation (Figure 2.33) at first intended for preparing, propelled by means of the 1981 BBC Micro. Creator Eben Upton's objective swung into to make a low-esteem device that would upgrade programming abilities and equipment data on the pre-school level [20].

In any case, because of its little length and reachable expense, it wound up noticeably rapid received through tinkerers, producers, and hardware fans for ventures that require more prominent than a straightforward microcontroller (comprehensive of Arduino devices) [29].

The Raspberry Pi is slower than a contemporary workstation or PC however keeps on being a whole Linux PC and may offer the greater part of the normal skills that recommends, at a low-control consumption organize.

Figure 2.33: Raspberry Pi

The Raspberry Pi end up plainly intended for the Linux working contraption, and a lot of Linux dispersions now have a model streamlined for the Raspberry Pi. Two of the greatest popular choices of Raspbian are, that is fundamentally in light of

the Debian working framework, and Pidora, which is essentially in light of the Fedora working contraption.

For fledglings, both of these functions are chosen to utilize an issue of individual inclination [20]. A suitable example of application may be clearly explain the main, which greatest painstakingly looks like a working device you're acquainted with, in either a PC or server condition.

On the off chance that would love to test with more than one Linux conveyances and do not know which one need, or just need a less confused appreciate on the off chance that something turns out badly, which remains for fresh out of the plastic new out of field programming program. When, first boot from the SD card, might be given a menu with more than one dispersions, (for example, Raspbian and Pidora) to browse. On the off chance that choose to endeavor a particular one, or if something turns out badly alongside your gadget, in actuality keep the Shift key at boot to come back to this menu and begin once again [21].

There are, obviously, a lot of different decisions. Open ELEC and RaspBMC are both working gadget appropriations essentially in view of Linux which are focused towards utilizing the Raspberry Pi as a media focus. There are likewise non-Linux structures, similar to RISC OS, which keep running on the Pi. A few people have even utilized the Raspberry Pi to get some answers concerning working frameworks by means of planning their own.

2.8 Summary

Rostrum is raised platform on which someone stands to make a public speech to the target audience and gives a Table top to preserve essential document. Lectern is a reading stand o desk upon which books or notes are positioned to allow one to examine whilst status up. Those term, having comparable definitions and bodily alike, they'll be used interchangeably at some point of this file.

Conventional lectern artwork layout are crafted from timber due to the truth that perspects are widely available and less complicated to fabricate. Later, lectern layout begins to include top adjustment to permit distinct stature speaker to present their speech easily.

A few height changes in the lectern layout are manually operated which require some motion of turning a crank or pushing a button to actuate the mechanism. Apart from the height adjustment technologies, lectern designs have developed other functions over the years and those encompass voice amplification, auxiliary display, adjustments for the disable, integration of contact display, light weighted material usage, storage mechanism and others. The technologies in growing a lectern appropriate for all are a masses.

The energy transmission device will be important for the layout functions so that the required characteristic may be realized. The strength transmission may be included into a few designs of the automatic peak adjustable rostrum a good way.

The sensors for proximity sensing the highlighted sensing technologies are photoelectric, capacitive, ultrasonic and inductive. Proximity sensing which is utilized

in robotic cellular. The vision system will also be applicable to feel human and with sure algorithm to height, the height adjustment may be achieved. Besides that, the face detection machine is play the primary roll to come across human face presence to offer signal to the controller to adjust the height of the lectern.

The literature review can be used to gain positive degree of information of the task. The subsequent chapter will discuss the methodology applies in this project.

CHAPTER 3

METHODOLOGY

3.1 Introduction

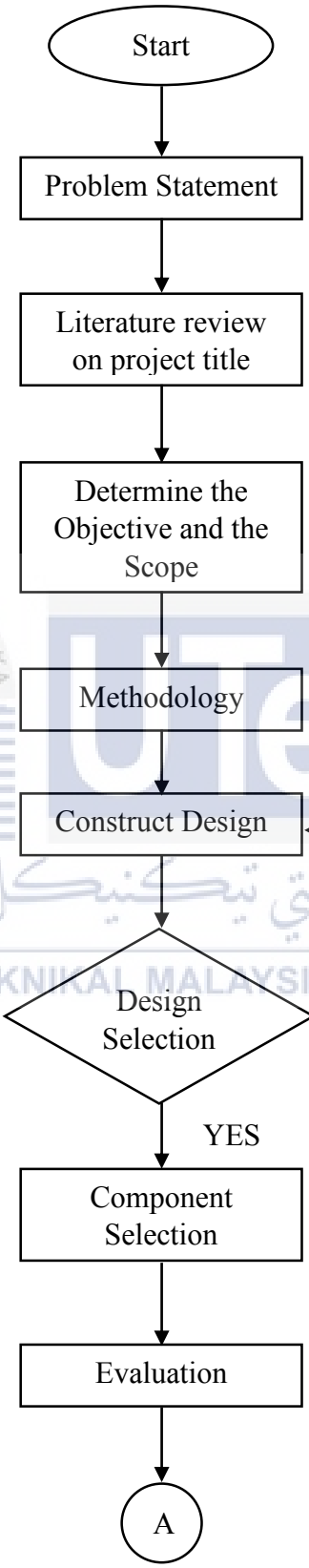
This chapter presents the methods that will be implemented in the course of the project. The chapter focus on the approach of the multiple design aspects which are conceptual derived to achieve the functional needs of the adjustable height mechanism. In addition, different type of sensor with positioning and placement of those sensors are planned and discussed here. In whole, the methodology chapter highlights the path and the way on how the project is going to be carried out and the methods which are going to be uses to achieve the started objective.

3.2 FYP Flow Chart

The process is important to layout the key elements and steps that will be conducted throughout the project. The project workings are separated into two parts to follow suit the two different semesters to complete the project. The first part of the project is named FYP1 and the second part is titled as FYP2. This part of the project relates to the understanding of the title and seeking reference on the automatic height adjustable rostrum. The introduction described clearly n the rostrum basic functions and definitions. Subsequently, the objectives and scopes are determined in line with the given resources and allocated time. Then, the literature review is composed by

seeking for journals, academic books, educational websites, patents and other relevant sources. The methodology will be discussed in this part to explain and layout the scheme how the project will be carried out. The final design of the project will be finalized as to fulfil the desired aspects and functions. The fabrication of the mechanical parts and the mechanism is done here with the integration of the electronic devices. The testing and the evaluation of the height mechanism will be carried to user with different statures. In addition to that, characteristic of the mechanism and the response of the sensor and camera are evaluated to reaffirm the project outcomes. Lastly, a conclusion will be drawn out to evaluate the result of the project and suggest future development of the study.

The project development flow will serve as a guide to complete the project with the relevant details and processes. The flow chart and the Gantt chart enables the management of tasks to be properly planned out with the suitable time frame and the appropriate use of resources. The project development flow of FYP is shown in Figure 3.1. Besides that the Gantt chart of FYP 1 (Table 3.1) and Gantt chart of FYP 2 (Table 3.2) shown below.



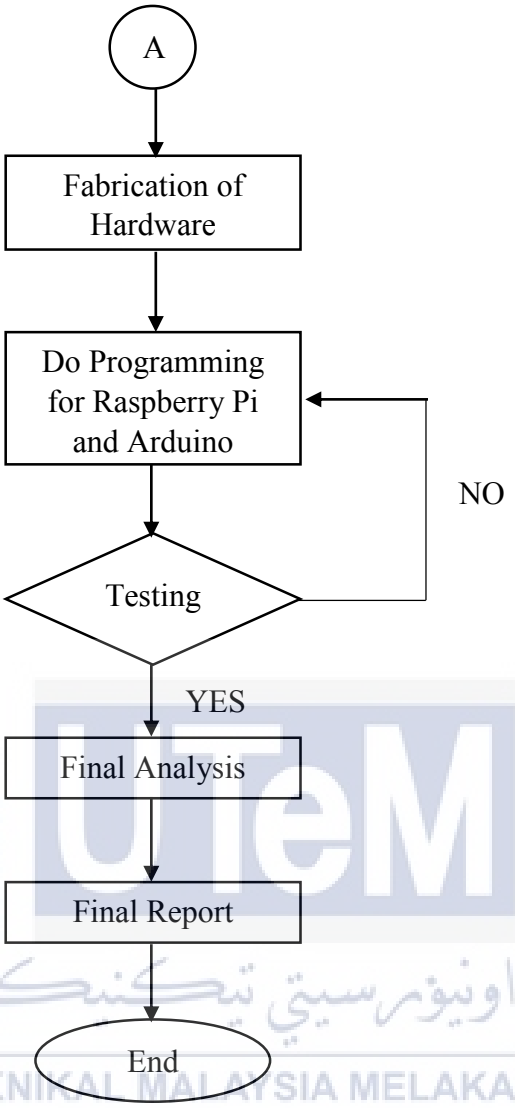


Figure 3.1: The flow of the project development for FYP

Table 3.1: Gantt chart for FYP 1

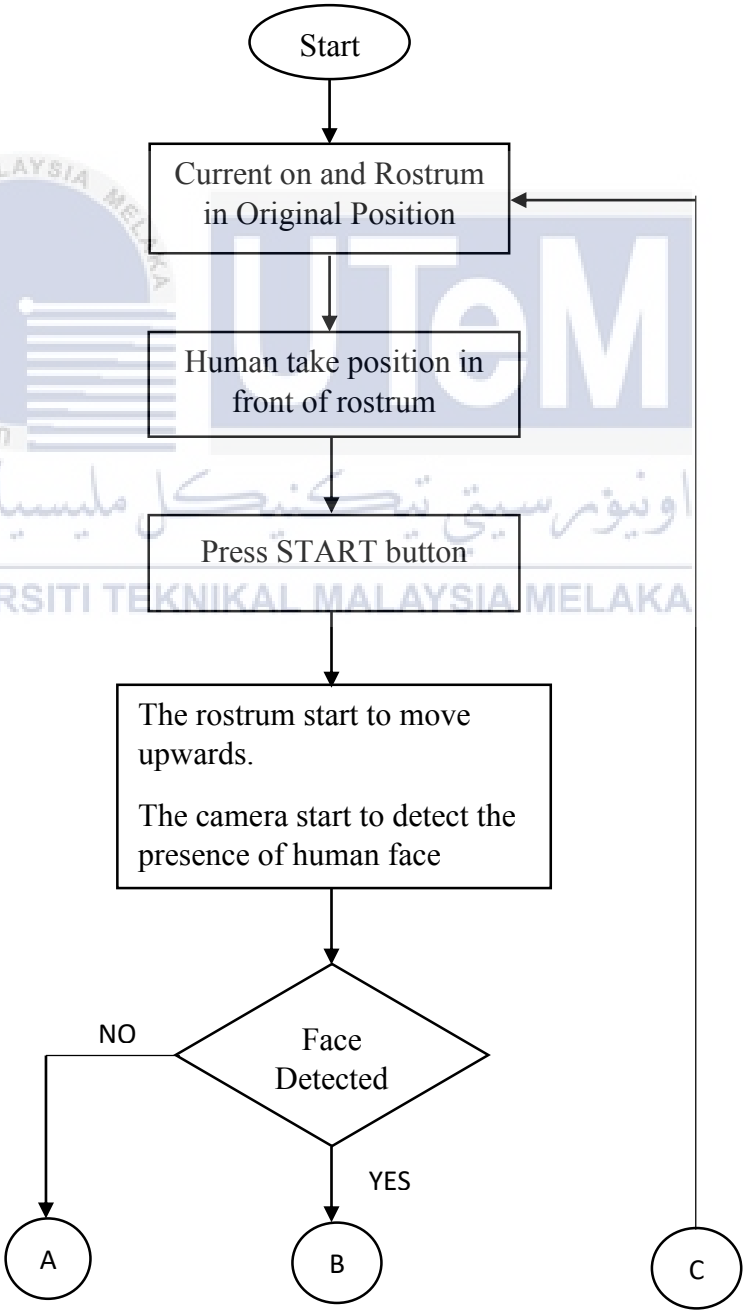
Activities of FYP1		Weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meeting With Supervisor														
2	FYP tittle conformation														
3	Article collection based on tittle														
4	literature review														
5	Problem identifications														
6	Construct Project Design														
7	Selection of Design														
8	Component Selection														
9	Preliminary Result														
10	Report Writing														
11	Presentation														
12	Submission of Report														

Table 3.2: Gantt chart for FYP 2

Activities of FYP1		Weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meeting With Supervisor														
2	Literature Review														
3	Fabrication of Mechanical Part														
4	Development of Electrical circuit														
5	Experiment Analysis														
6	Modification														
7	Final Analysis														
8	Report Writing														
9	Presentation														
10	Submission of Report														

3.3 Process Flow

Project flow is one of the very important element for any kind of project. Project flow is shows the system flow or on how the system works in step by step. In this project the project flow is combine all the systems together and show the full process of the project. The flow chart below shows the process flow of this project.



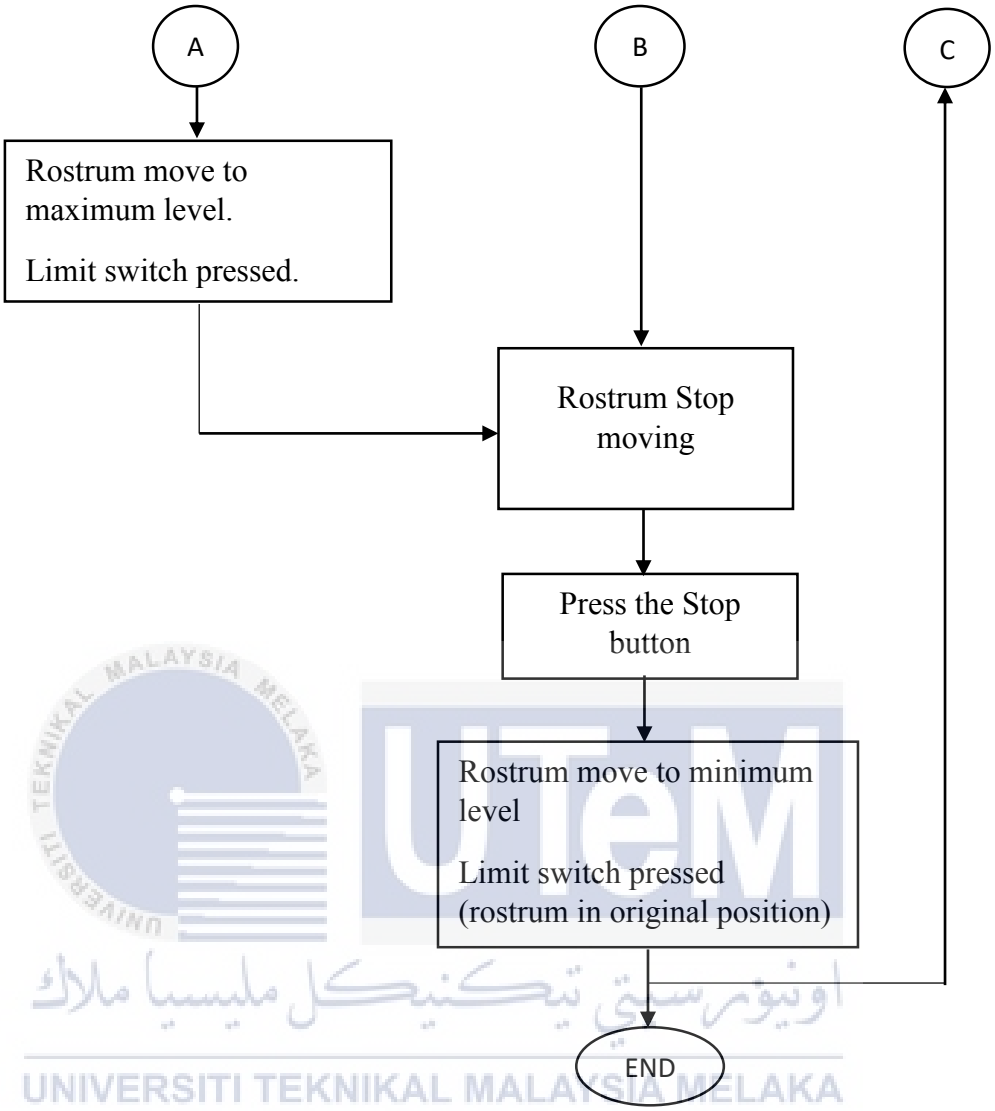


Figure 3.2: Process flow chart of the project

As shown in Figure 3.2, the process starts when the power supply is turn on, when the current is given to the system, the system will energize and it makes turn on the whole system. Before start this system, a user need be take position exactly in front of the rostrum and the user must be stand straight to the rostrum. Once user take position, then press the start button to turn on height adjustment system, the start button send signal to Ardunino and the Arduino will give signal to the Raspberry Pi, then the Raspberry will be activate the pi camera.

Face detection system is included with the project, so when the camera is active, the rostrum will start to move up vertically and the camera will start to detect the presence of human face. Once the camera detected any human face then the camera will send the signal to the controller and the controller will stop the rostrum from moving up. So the position of the rostrum stop is the correct position and it will be the comfortable position for the speaker. If the camera dose not detect any faces, the rostrum will move up to the maximum level until the maximum limit switch is pressed. Once the maximum limit switch is pressed the rostrum will stop.

The stop button have to be pressed to let the rostrum back to its original position which is minimum level of the rostrum, when the stop button is pressed, then it will move down vertically to minimum level with detecting face until it reaches the minimum limit switch. Once the camera detect any presence of human face the rostrum will stop moving and if not face detect then the rostrum will move to the original position. The original position of the rostrum is when it touch the minimum limit switch. If the camera dose not detect any face then the rostrum will stay at the original position. The restart button can be press to repeat the process if the camera is fail to detect the human face although there is a human presence in front of the rostrum.

The face detection system is playing the main role for the height adjustment process. The face detection is also can be declare as a sensor for this system. While the rostrum moving, if camera detect any presence of human, then the signal for the camera will give to the controller to stop the rostrum's motor movement. So the stopped position is considered as the comfortable position for the user. So, the more the accuracy of the face detection, the more the comfortability of the rostrum height for the user.

3.4 Concept and Ideas

The concept and ideas of the project is the level where thoughts of the functionality and the corresponding devices, material, mechanism and related aspects come into play to formulate a conceptual design. The design of the project should have two key features which are the height mechanism and the detection method. All the conceptual designs revolve around these two key features and subsequently three designs will be creatively generated for analysis purposes. A list of ideas and concept are made so that it could be converted to the proper specifications.

3.4.1 Design

The design process is a critical process in determining the relevant mechanisms, sensor, material and technique of fabrication. The design level is important because the relationships to the future parts of the project development. The design processes are discussed in detail in the following section.

The conceptual designs are implement with respect to the different mechanism studied in the before chapter correspond to the matching material and the placement of sensor and camera. The design flow chat in this project is shown in Figure 3.3.

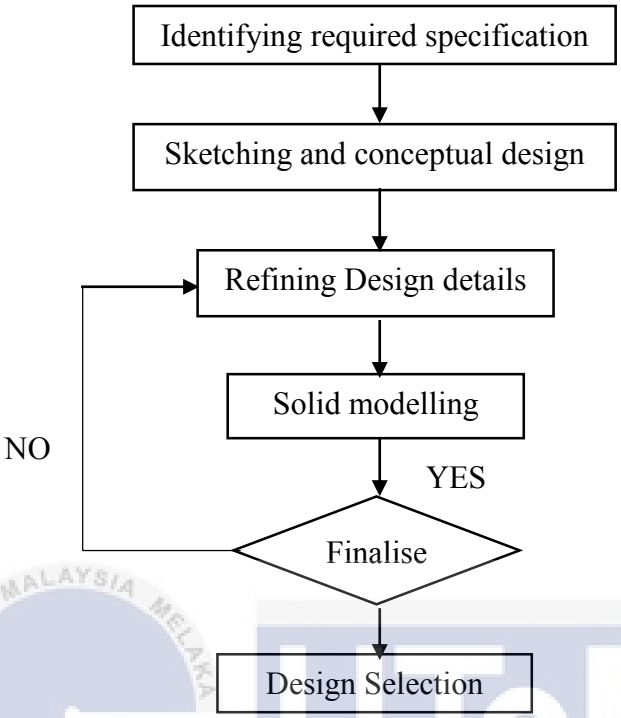


Figure 3.3: Design Flow chart

The design selection of the rostrum will be based on two methods which are the concept scoring method and design analysis. The methods will be used to weight the chosen design for future consideration. The Figure below (Figure 3.4) shows the design selection process.

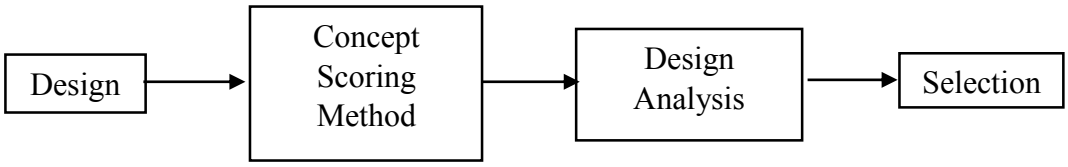
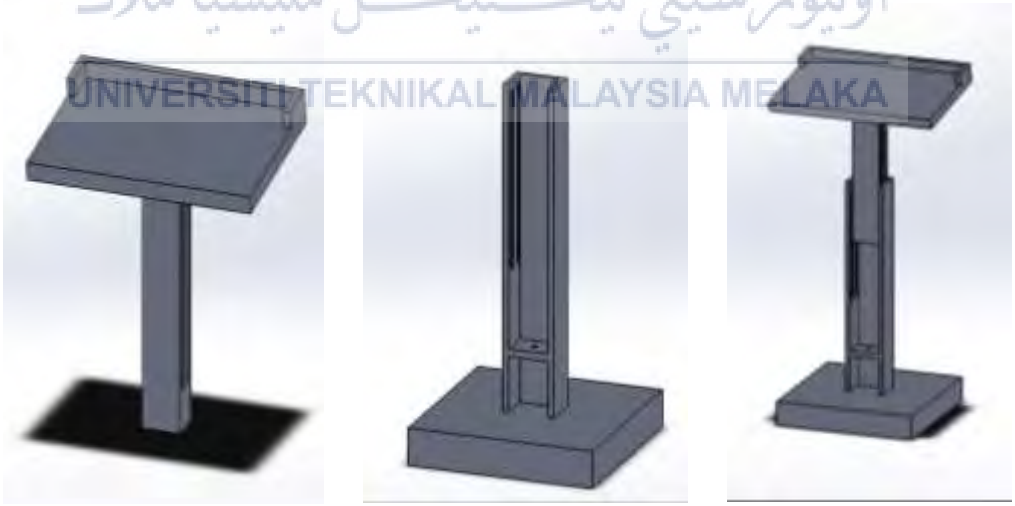


Figure 3.4: Design Selection

The concept scoring technique is a technique of weighting relative vital of the choice standards and specializes in the comparisons of each criterion. This is critical due to the fact the very last layout of the venture will proceed into fabrication and development degree that's vital to the assignment itself. The desk is generated with regards to the concept scoring method that is commonly used in product design and development [19].

The design analysis will be done to analyse performance on design to each aspect that may be left out of consideration from the concept scoring. The designs will be sensibly discussed on the advantages and disadvantages for the important aspects.

As per all the methods, a design was design and finalised based on all the criteria which discussed before in the previous section. The finalised design is shown in the Figure below (Figure 3.5)



Top Part Bottom Part Together (combine)

Figure 3.5: The finalised design of the rostrum

3.4.2 System Development

In this venture the mechanization arrangement of the task is created by utilizing the face location framework. Face identification is a PC innovation being utilized as a part of an assortment of utilizations that recognizes human faces in computerized pictures. Face discovery likewise alludes to the mental procedure by which people find and take care of appearances in a visual scene. In this task the face location framework is utilized to identify the human face nearness to auto change the stature of the platform.

There are several methods to detect human face presence using camera, based on the literature review done in the previous chapter, the method called corner point detection is chosen to use in this project. Corner point identification is an approach utilized inside pc vision frameworks to remove certain sorts of highlights and induce the substance of a picture as appeared in Figure 3.6. Corner location is much of the time utilized as a part of movement discovery, picture enrollment, video following, picture mosaicing, scene sewing, 3D displaying and protest acknowledgment. Corner location covers with the theme of intrigue point recognition.

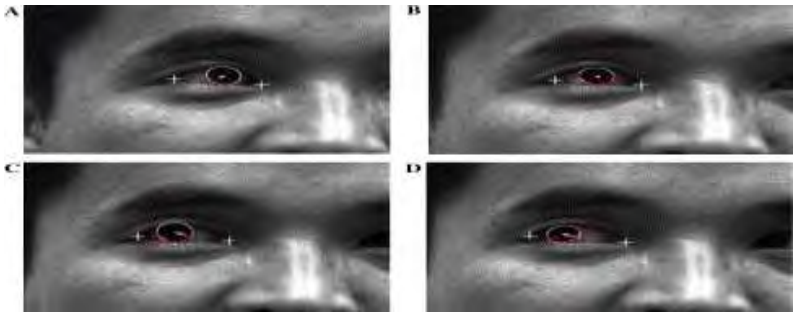


Figure 3.6: Human eye corner point detection

3.5 Component Selection

In this section will discuss the hardware that will be used in this system. In the previous researches, some of the researchers used Microcontroller, Arduino, PID Controller, Fuzzy Controller, Data Acquisition System as the controller but compare to previous researchers rarely used Arduino Controller. For this project I have chosen Arduino because it is faster, easy to learn and more advantages compare to other controllers. Then, to detecting the human face presence, Raspberry Pi and Pi camera is used. The DC motor and Lead Screw is used to make the movement of the rostrum vertically up and down. Other than that, Relay is used to control the movement of the motor and the direct power supply from the adopter is connected to the relay to give power to the DC motor which is connected to the relay. The movement of the motor is controlled by the relay, and the system is directly connected to the adopter (direct power supply)

3.5.1 Arduino Uno

Arduino uno is a microcontroller board on the ATmega328Pand their each name of the pins. The operation voltage of this controller is 5V. It has 14 digital input/output pins which 6 can be used as PWM output, 6 analog inputs, a USB connection, a power jack and a reset button as shown in Figure 3.7. The Arduino is used as the main controller for this project. All the other components were connected to the Arduino, and Arduino is the centre of the process and signals is given to actuator by the arduino. Raspberry pi is connected to the Arduino so give input signals to the Arduino as well as the start switch, stop switch and also the limit switch. The output signal which the signal from the Arduino is given to the relay to control the movement of the motor. The programming for the controller was done by using C++ language and the programming was done based on the connection of the Arduino and other components.

A circuit design was designed to check the connectivity of the parts to the controller and also the performance of the system after the programming is done as shown in Figure 3.8. Once the simulation of the circuit is success, then the circuit design was applied in the real controller and the other parts.

Figure 3.7: Arduino UNO

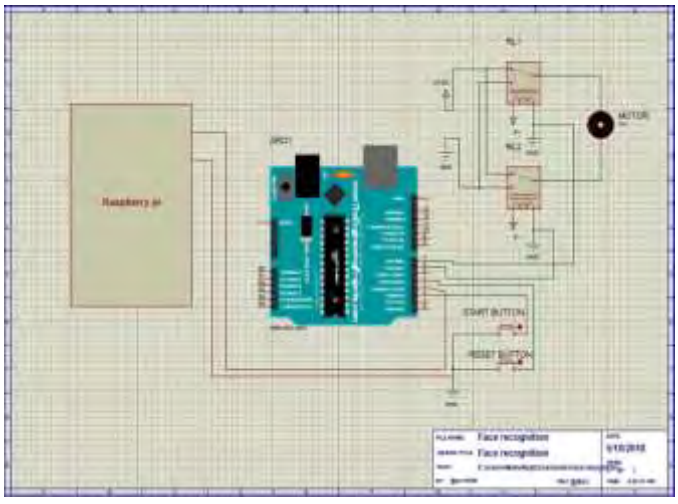


Figure 3.8: Circuit Design

3.5.2 Raspberry Pi

The face detection system was developed in the raspberry pi. The face detection system was created by the Open CV library. Open CV library is the library of the detection system. So the face detection method from the Open CV was installed into the Raspberry pi and the method was train into the raspberry pi to detect human faces, once the training process done the Raspberry pic is tested with several human faces to see the accuracy of the system detection. This face detection system is works a detecting sensor to control the height of the rostrum.

3.5.3 Relay Module

Relay module is well known as motor driver or as relay. The function of relay is to change the direction of rotation of motor, from clock wise to anti clockwise or from anti clockwise to clockwise. The function of the relay is exactly applied to this height adjustment system. When the relay receives signal from the Arduino, then the relay will make the motor to move and also will change the direction of the rotation when receive signals from the controller. Power adaptor also directly connected to the relay so the relay will supply the current for the motor when the motor need to be run. The relay has been used for the rostrum is as shown in Figure 3.9.

Figure 3.9: Relay Module

3.5.4 DC motor

A DC geared motor (SP 20K-50K) as shown is Figure 3.10 is used to move the rostrum vertically up and down. The gear motor was placed in the bottom of the rostrum. Lead screw and coupling is joined with the motor the make the movement much smooth. The motor is activated by the relay, the movement of the motor will be depends on the signal of the relay whether it is clockwise or anti clockwise. The DC motor is high torque so the motor able to move the weight of the upper part of the rostrum vertically upwards.

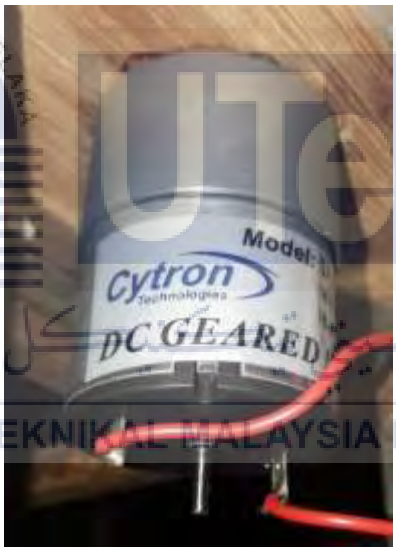


Figure 3.10: DC Geared Motor

3.5.5 Lead Screw and Coupling

Lead screw is a actuating mechanism and its help to make movement of an object in vertically or horizontally. A 3D printer's lead crew was used to this rostrum.

The lead screw position in this rostrum is very important, because the lead is directly joined with the motor by using coupling. Coupling is help to join the lead and the motor's lead and also its help to make a smooth movement. The lead is in lower part of the rostrum and the screw of the lead is joined in the upper part of the rostrum. So that when the motor rotates anti clockwise the lead also rotated together with the motor and the screw will upward. And when the motor rotate in clockwise then the screw will move down. The movement of the rostrum is depend on the movement of the screw. The joined coupling and lead is as shown in Figure below (Figure 3.11).

Figure 3.11: Lead Screw with Coupling

3.5.6 Switches

There are mainly four switches used in this rostrum; Start button, stop button, upper limit switch, and lower limit switch. Start button is to activate the face detection system and to move the rostrum vertically up. So when the start button is pressed the rostrum will move upwards while the camera detect for human face presence.

Secondly stop button. The stop button will activate the motor to rotate in clock wise, so the rostrum will move down. Next switch is, upper and lower limit switch. The upper limit switch is to stop the motor when the rostrum reaches the maximum height and the lower limit switch is to stop the motor when the rostrum reaches the minimum height. These are the four main switches which is really very important for this rostrums height adjustment system is as shown in Figure 3.12 and Figure 3.13.

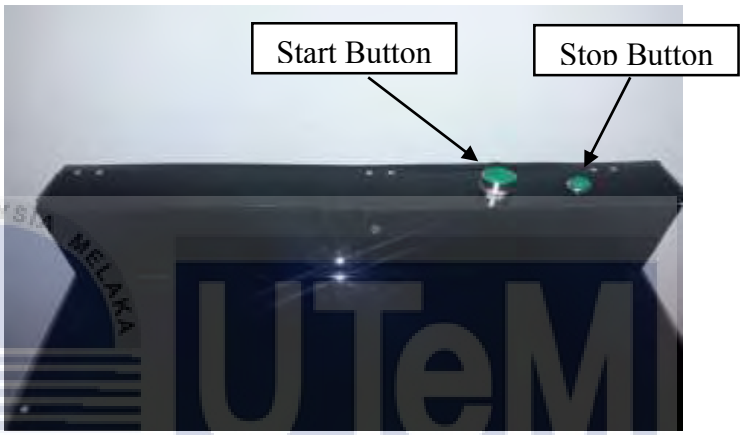


Figure 3.12: Start and Stop button

Figure 3.13: Upper and Lower Limit Switch

3.5.7 Combination of Components

All the parts were connected with the Arduino and the programming were done for each and every components so the flow of the system can be smoothly run. Once all the components done tested, the components were fixed into the rostrum body as shown in the Figure 3.14 (a) and (b).

(a) (b)

Figure 3.14: The complete Rostrum

3.6 Experimental Setup

Assessment is a branch of science which considers constant changes and incorporates the hypotheses of coordination, separation, measure, limits, expository capacities and boundless arrangement. It is the orderly investigate genuine and complex-esteemed constant capacities. It depicts both the subject of which analytics is a part and one type of the outline decision making ability thought.

This part is discusses the analysis and the result which is going to be evaluate in the FYP 2 which mean after completing the project fabrication and the whole system. The analysis is divided into two parts which is for the rostrum automation system and face detection system. There were four experiments done, which are height accuracy experiment, accuracy on face detection experiment, height vs time experiment and last but not least light intensity vs face detection accuracy experiment.

3.6.1 Experiment for Height Accuracy

The experiment was carried out to test the precision of the rostrum positioning depending on the users face detection. The input voltage given from the Arduino then the voltage was supplied to relay module which provide the signals to the motor. This test will verify the precision of the rostrum. The test was done with five times of repeatability.

First of all the procedure of the experiment was conducted by connecting the DC motor to the relay, then the relay is connected to the Arduino. The input voltage for the Arduino is given by the raspberry pi, so the raspberry pi is connect with the Arduino and to a monitor via HDMI cable. After that, develop and upload the Arduino

coding for the test to the Arduino Uno board and also create the face detection system in the raspberry pi. The experiment was tested by using five different people who are with different heights which is 189cm, 185cm, 180cm, 175cm and 170cm. a fixed position was set in front of the rostrum to conduct the test and each person's body posture was remain straight during the test. The data from the test were collected and tabulated into tables.

3.6.2 Experiment of Determining Accuracy on Face Detection

The experiment was carried out to determine the accuracy of face detection in rostrum when it moves from one point to another desired point. Once the fabrication of this mechanism is done, this experiment was conduct to verify whether the system is operating based on its requirement. This test will prove the accuracy of the camera in detecting the humans face.

The face detection system was created in raspberry pi by using the Open CV face detection. After generate the system the raspberry pi was connected to the monitor and pi camera, when the system is ready for the detection, the accuracy test was made by using five different people. The light intensity was fixed for all the five people. The accuracy percentage of the face detection was recorded and tabulated in table. The overall evaluation of the system is collected using calculation theory by referencing certain formulas. Formula 4.1 shows the equation of error rate, 4.2 shows the equation of accuracy and 4.3 shows the equation of mean of the error rate.

- True Positive = Video frame with road sign is precisely detected and recognised as having road sign by the experiment.
- True Negative = Video frame without road sign is precisely detected and recognised as having no road sign by the experiment.

- False Positive = Video frame without road sign is incorrectly detected and recognised as having road sign by the experiment.
- False Negative = Video frame with road sign is incorrectly detected and recognised as having no road sign by the experiment.

$$\text{Error Rate} = \frac{\text{Total number of false positive}}{\text{Total number of false positive} + \text{Total number of true positive}} \quad (4.1)$$

$$\text{Accuracy \%} = 100 - \text{Mean of total error rate} \quad (4.2)$$

$$\text{Mean of total error rate} = \frac{\text{Total error rate}}{\text{Total number of test}} \quad (4.3)$$

3.6.3 Experiment of Height vs Time

The experiment was carried out to study the relationship between the height adjustment and time taken for the rostrum to reach its desired position. From this experiment, the speed of the motor can be calculated.

The rostrum was set at its original position and then the start button pressed by the user so the rostrum will start to move upwards until the pi camera detect any face presence. A stop watch was used to determine the time taken, so the stop watch will start when the start button of the rostrum is pressed by the user and the stop watch is stopped when the rostrum stopped after detected face presence. The length from the original position to the stopped position and the time taken was recorded. The test was repeated for three time with five different people.

3.6.4 Experiment of Light intensity vs Accuracy

The experiment was carried out to determine the relationship of light intensity affecting the accuracy rate of the face detection. This experiment was conducted in three different condition which are very bright, bright, and less bright. Each test was conducted with three times of repeatability.

The lighting for each condition are different. The raspberry pi, arduino, relay and motor were connected to the rostrum. The rostrum was placed at a fixed position and the light intensity was measured using a light meter application. Light meter application is similar as lux meter, the light meter application is use light sensor of mobile phone to determine the light intensity. Then the face detection system is activated to see the accuracy of the face detection. The light intensity and the face detection accuracy percentage was recorded and tabulated into table.

3.6.5 Experiment of Camera Positioning

The experiment was carried out to determine the relationship between the position of the pi camera and the height change. This experiment was conduct by three different angle of camera position which are 0º, 10^0, 20º. The position setting of the camera is as shown in figure 3.15.

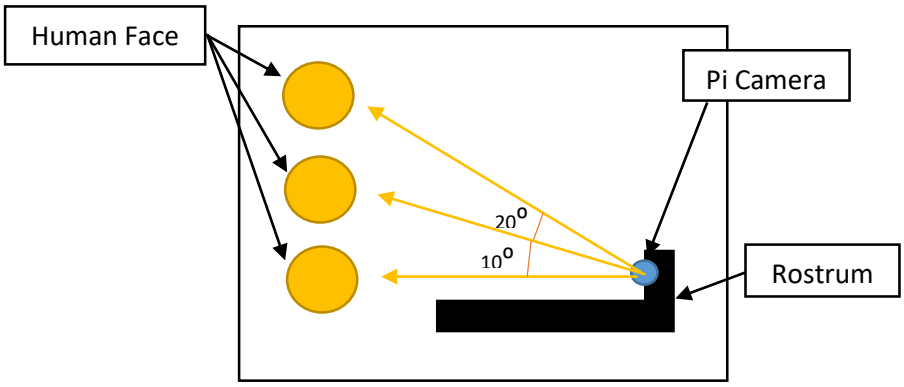


Figure 3.15: The three different position of pi camera

First of all the camera was set in 0º and the system was started with a person to see the confortability of the change of height in the rostrum. The test was repeated for 3 person with three different setup angle of the pi camera. The result of the experiment was recorded and tabulated in a table.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter, the results will discussed from the experiment done from the Development of Face Detection System for Auto Lifter Rostrum. The results on this system were obtained by running the source code manually in Arduino software. This experiment has shown the prove of the system performance and accuracy.

The data collected from this experiments were tabulated into the tables and it was further analyse by plotting into graph. The experiments are very important to measure a system's performance and precision. Each graph and table was describe briefly. The Table 4.1 shows that the list of experiments that has been conducted for this project.

Table 4.1: List of experiment

No	Experiment
1	Analysis of Accuracy on Face Detection
2	Analysis of Light intensity vs Face Detection Accuracy
3	Analysis of Camera Positioning
4	Analysis for Height Accuracy
5	Analysis of Height vs Time

4.2 Analysis

4.2.1 Analysis of Accuracy on Face Detection

In this analysis part, Pi camera is the main concern. The signal to stop the movement of the rostrum is given by the Pi camera when the camera detect any human face presence. So the Raspberry Pi was connected to a monitor and 5V power was given to the Raspberry pic. Then the OpenCV face detection tool was installed into the Raspberry pi and the train the tool to the Raspberry Pi. This process was took some long time to install and train this tool to the Pi. After done installing, the programming and coding was generate for the face detection into the Raspberry Pi.

Once the coding are done, the coding had been run in the tool, and a display was pop out, and the camera started to work. The display showed the view from the camera and at the same time it will show a green box around the detected face in the

display when the camera detect any presence of human face. The experiment setup for this analysis is as shown is Figure 4.1.

Figure 4.1: Experimental setup for the face detection

This experiment process was started and experiment was repeated by five people and each of them repeated the test for three time. All the result from the experiment made was record and tabulated in a table as shown in Table 4.2

Table 4.2: The result of the accuracy of face detection

No of Test	**Person A**	**Person B**	**Person C**	**Person D**	**Person E**
1	98.92%	99.07%	96.87%	99.85%	97.71%
2	99.20%	97.41%	99.09%	99.23%	98.59%
3	98.15%	96.77%	98.89%	99.62%	99.28%
Average	**98.76%**	**97.75%**	**98.28%**	**99.57%**	**98.53%**

Based on the results in Table 4.2, graphs was plotted. There were two graphs, first graph is the face detection percentage of all the five people in test 1, test 2, and test 3, the other graph is the average percentage of all the three test made. The graph of the results are as shown in Figure 4.2 and Figure 4.3.

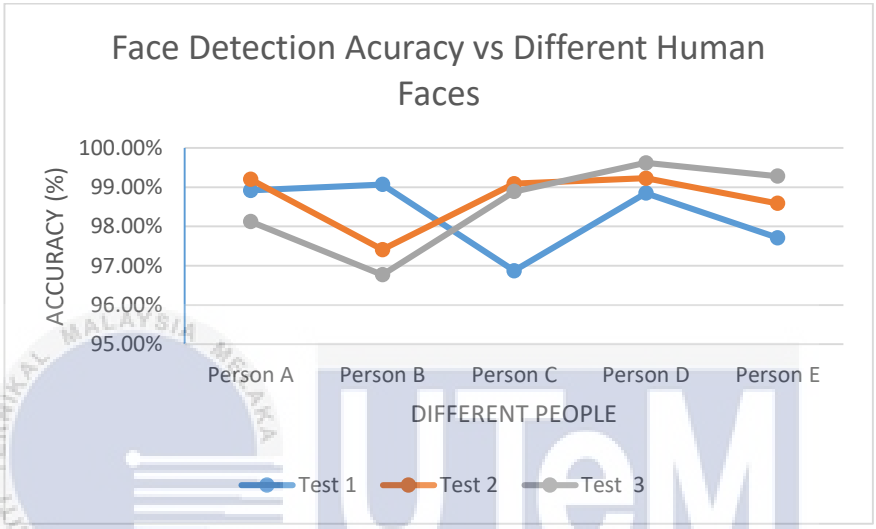


Figure 4.2: Graph of Face Detection Accuracy vs Different Human Face

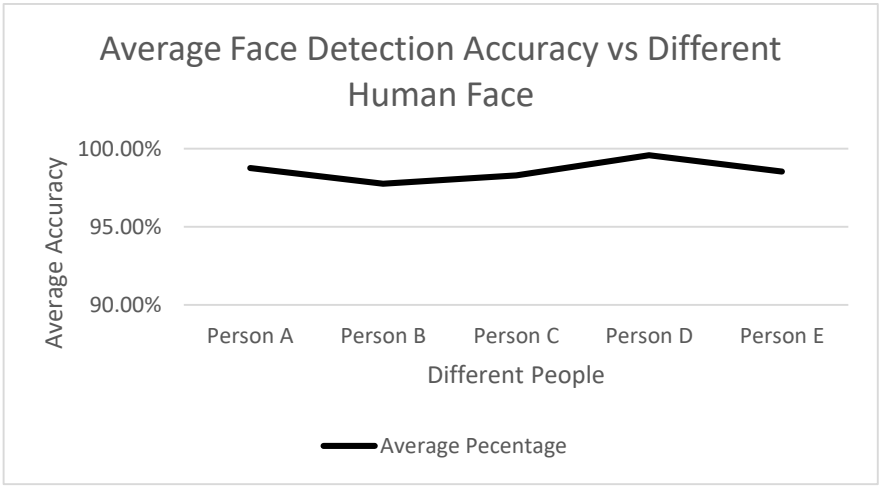
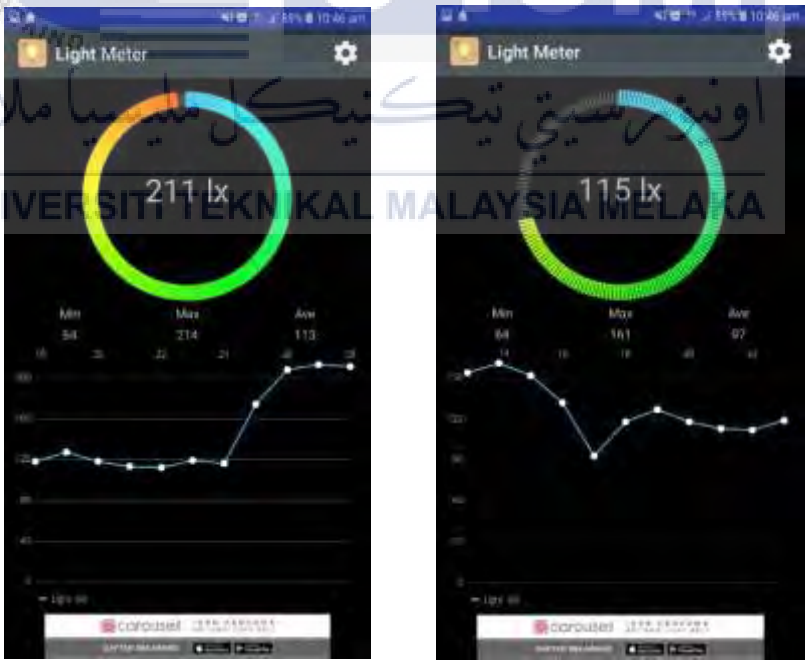


Figure 4.3: Graph of Average Face Detection Accuracy vs Different Human Face

The result and the graph shows that the system is already ready to detect human faces. Although it was not really 100% accurate but the system still can detect the presence of human face for more than 90.00% accurately.

4.2.2 Analysis of Light intensity vs Face Detection Accuracy

The light intensity do always effect the camera view, so this analysis made to identify the light intensity versus Face detection accuracy. The experiment setup for this part was uses the same setup as the previous analysis because the difference for the previous setup and for this setup is just the different light intensity as shown in Figure 4.4.



(a) Very Bright (b) Bright

(c) Less Bright

Figure 4.4: Light intensity

So, the setup was placed at three difference placed which is, slightly dark place, bright place and very bright place. A person is used to be stand in front of the camera to test the system's accuracy. After, the person stand in front of the camera, the system is turned on by another and the camera started to detect face presence in the camera frame. Once face is detected, the accuracy percentage is shown in the screen. If there were no face found then the display will not show any accuracy percentage. The experiment was repeated three time at each place and the result of the experiment was recorded as shown in the Table 4.3.

Table 4.3: The result of the accuracy of face detection at different places

Light Intensity	Test 1	Test 2	Test 3	Average
Very Bight (lx)	98.70%	99.87%	99.63%	99.40%
Bright (lx)	97.69%	98.24%	97.81%	97.91%
Less Bright (lx)	93.47%	96.97%	96.22%	95.55%

From the collected data, an average accuracy was calculated and all the data was potted in graph and bar chart. The graph is as shown in Figure 4.5 and the bar chart is as shown in Figure 4.6

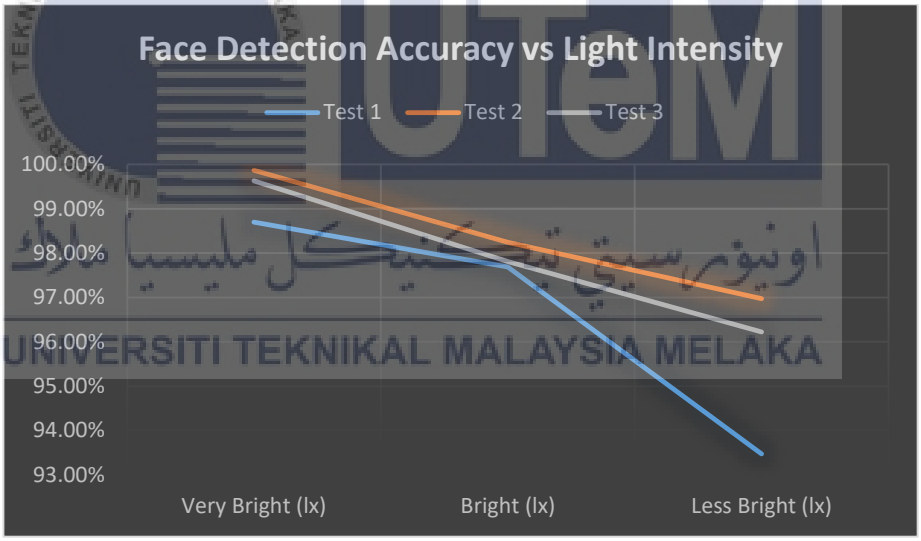


Figure 4.5: Graph of Face Detection Accuracy vs Light Intensity

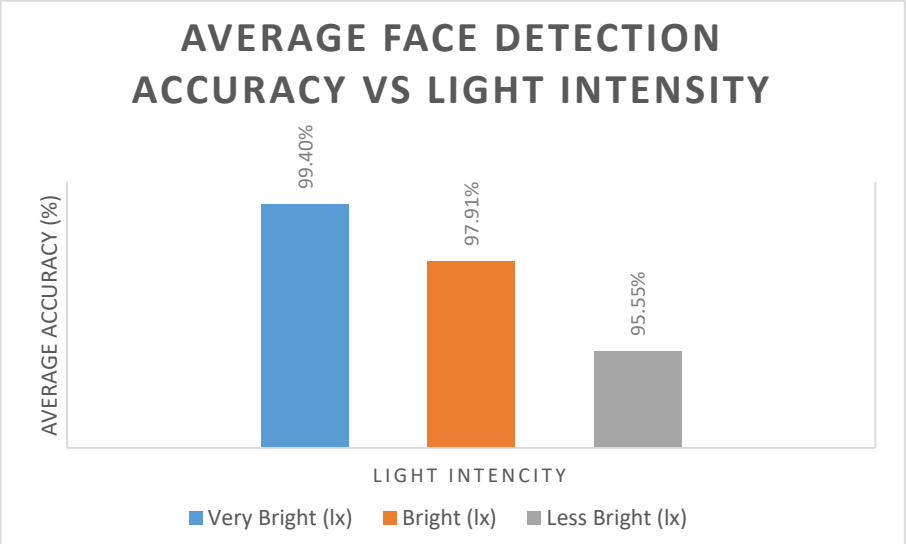


Figure 4.6: Bar Chart of Average Face Detection Accuracy vs Light Intensity

The accuracy of the face detection were different for each of the light intensity, when the light intensity was in very bright, the accuracy was around 99.00%, while when the light intensity was bright, the accuracy was around 97.00% and last but not least, when the light intensity was less bright the accuracy was around 95.00%. This shows that the camera can detect the human face in all the different light intensity but the different is the accuracy of the detection. So this face detection is suitable to use at all these three light intensity areas.

4.2.3 Analysis of Pi Camera Positioning

In this analysis part, the same experiment setup as the previous experiment was used. The main concern of this analysis part is the position of the camera and also the angle. After done creating the face detection system, the camera was placed in the rostrum. The camera was placed into the rostrum in three different angle to identify the correct position of the camera as shown in Figure 4.7.

(c) 0º (a) 10º (b) 20º

Figure 4.7: Position of camera

The test was begin, a person was placed in front of the camera and the start the face detection system and the rostrum move vertically up and the rostrum stop when the camera detect face presence. The comfortability of the person stands in front of the rostrum is recorded and tabulated. The comfortability of the rostrum's stopped position was rated by the user from zero to five, which mean zero is very uncomfortable and five is very comfortable. The test was repeated by five different people for all the three different position of the camera. All the collected data was recorded and tabulated as shown in Table 4.4

Table 4.4: The result of the camera positioning test.

Angle of Camera	Comfortability Rating from 0 - 5				
	Person A	Peron B	Person C	Person D	Person E
0º	0	0	0	0	0
10º	1	2	1	0	1
20º	5	5	5	4	5

The result of the analysis which has been tabulated in Table 4.4 then plotted in bar chart to see the clear result in the confortability of the users in the rostrum stopped position. The plotted bar chart is shown in Figure 4.8

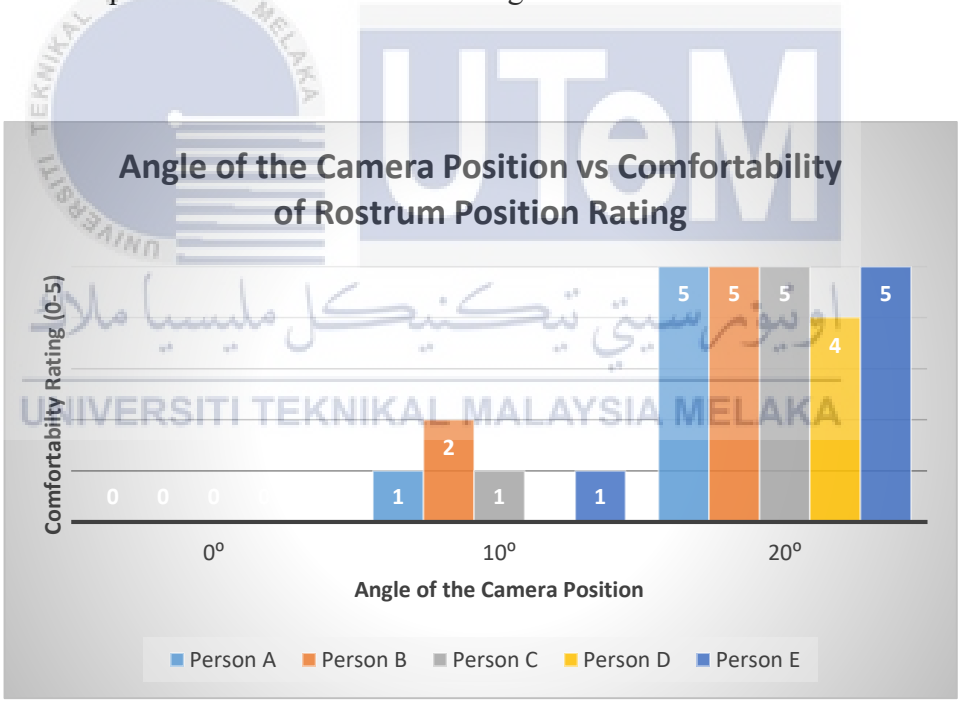


Figure 4.8: Bar chart of Angle of the Camera Position vs Comfortability Rating

From the bar chart and the result that had recorded from the analysis, the most perfect camera position angle which move the rostrum to the comfortable height for the users is 20º, because for the other two angles, the comfortability rating by the

peoples were very poor compare to the 20º. Besides that, the four out of five people were given the highest rating which the solid five and only one person rated four.

4.2.4 Analysis of Height Accuracy

Once the fabrication of the project has been done, the project continued with the height adjustment testing. The figure 4.9 shows that the people with five different heights. The figure 4.10 shows the circuit design that have been done to create the real circuit for the system.

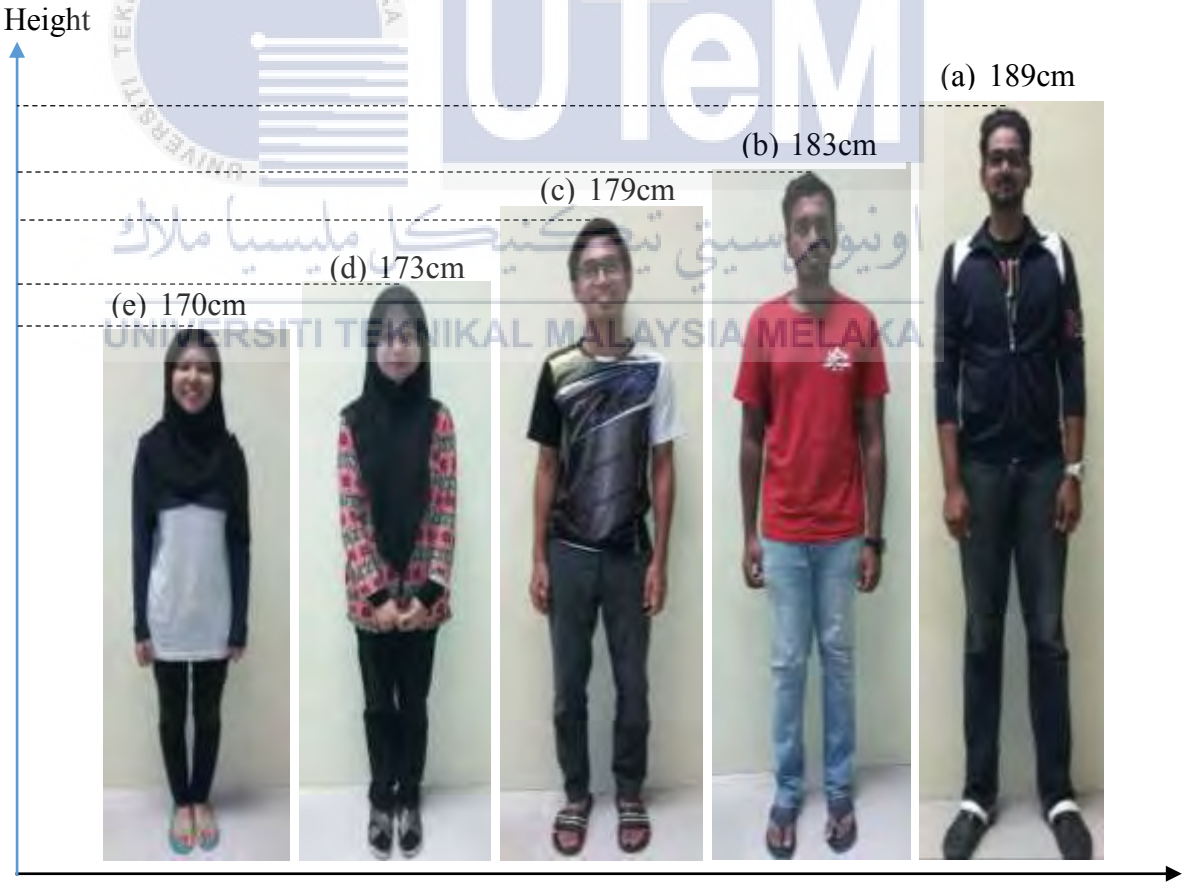


Figure 4.9: Five People with Different Height

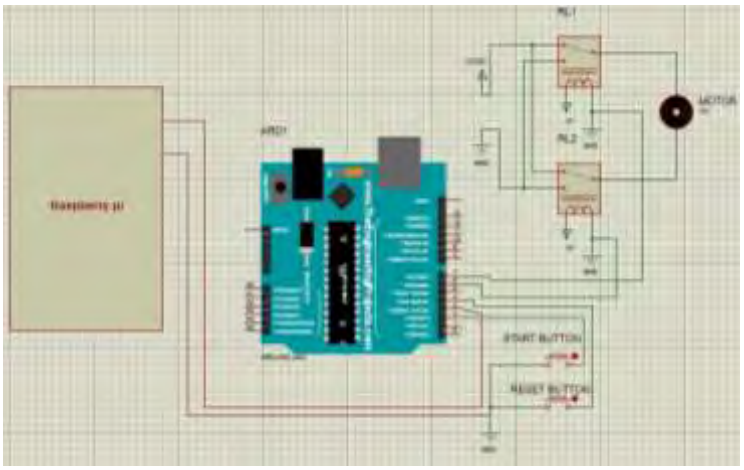


Figure 4.10: Circuit Design

Firstly a coding for the controller was generate by using the C++ language, once the coding was tested using the simulation of circuit design then the coding was uploaded to the Arduino. After uploading and compiling the programming from the computer to Arduino Board, a light will appear and blinking. This is because the Arduino give signal that the coding already uploads at the Arduino board. Then the Raspberry Pi and the relay is connect to the Arduino board according to the circuit design that have been done before. Once done connecting the wires the setup was set in a place in the rostrum. When the power supply is turn on, the red colour light will be blinking in the pi camera that means the camera is ready for the detection and also the light will be blinking in the raspberry pi and Arduino so the system is ready to start. All the circuit was fixed into the rostrum. Before start the experiment, the rostrum was placed in a placed and a 'X' mark was made in front of the rostrum as shown in Figure 4.11, so that all the five people who will do the testing will be standing at the marked area.

Figure 4.11: Rostrum and ‘X’ Labelled area

The experiment was start with the first person (person A). Person A was take position in front of the rostrum which the place marked ‘X’. Once the person in correct position then person A pressed the start button, the Arduino gives signal to the motor to move the rostrum vertically upwards, and also the Pi camera start to detect presence of human face. The rostrum stops once the Pi camera detect the person A’s face. The height of the rostrum is recorded, and the test was repeated for five times for each person. The height of the rostrum, and the difference between the height of rostrum and height of the person is recorded as shown in Table 4.5.

Table 4.5: The Result of the Height Accuracy Test

Testers	Height of the Rostrum Stopped After Face Detection (cm)					
	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Person A	108cm	111cm	110cm	110.5cm	111cm	110.1cm
Person B	111cm	113cm	111.5cm	112.5cm	112cm	112cm
Person C	120cm	121cm	120.5cm	120cm	121cm	120.5cm
Person D	124cm	123cm	124cm	124cm	125cm	124cm
Person E	129cm	129cm	130cm	127.5cm	128.5cm	128.8cm

All the tabulated data were plotted into graph to see the accuracy of the rostrums performance. The first graph in Figure 4.12 shows the rostrum's stopped height for all the five test with the five people and the second graph in Figure 4.13 shows the average height of the rostrum stopped in all the five tests for each of the person tested.

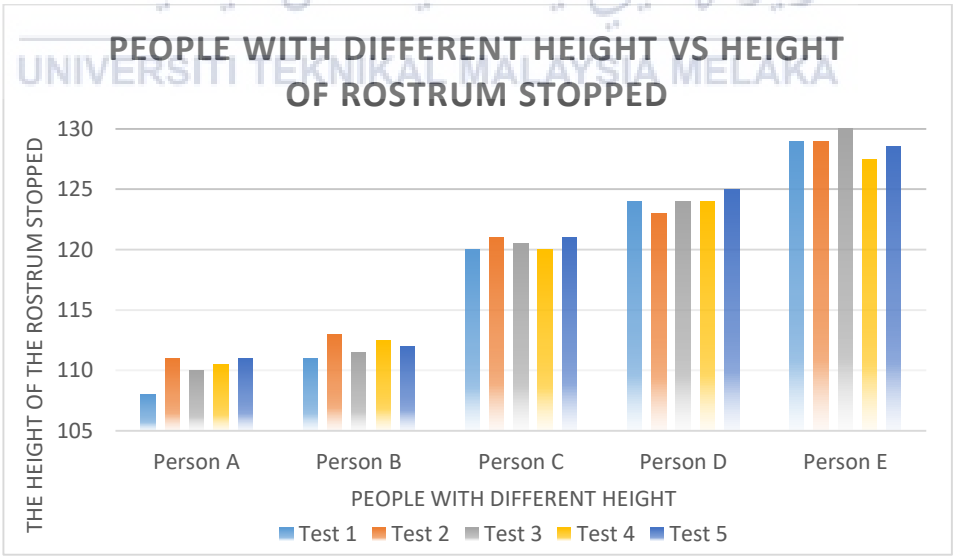


Figure 4.12: Bar Chart of People with Different Height vs Height of Rostrum Stopped

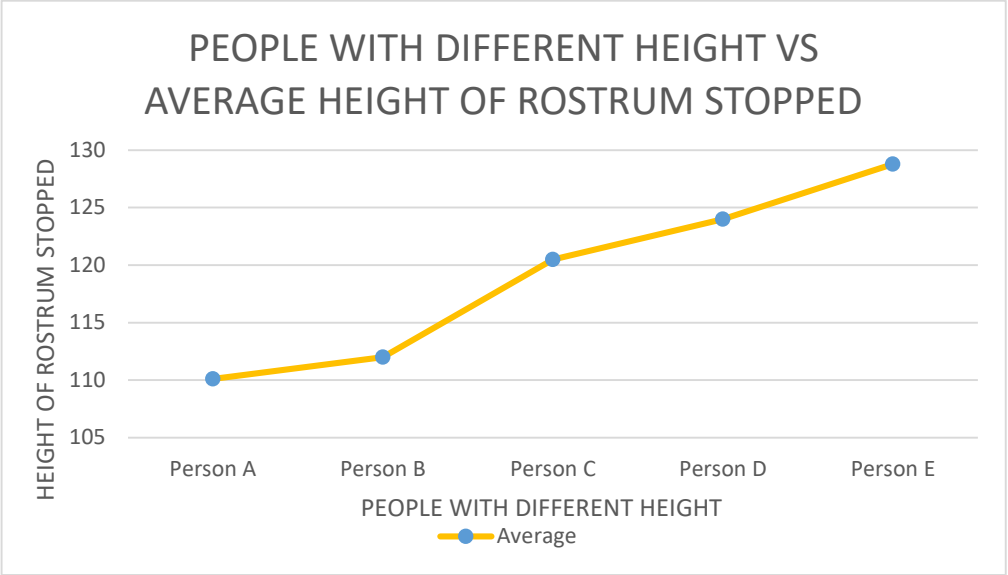


Figure 4.13: Graph of people with different height vs average height of rostrum stopped

The both graph and bar chart shows that the height of the rostrum stopped each person in the all 5 test were almost similar and difference in the height of the rostrum stopped in each test were very less. Although the height of the rostrum stopped is not 100% accurate, the error of the height is very less. The average height of the rostrum stopped is very close to the height of the rostrum stopped for all the 5 test.

4.2.5 Analysis of Height vs Time

In the previous analysis, it was about measuring the height change of the rostrum from the original position to the desired position, but in this analysis it was used the concept but the different is, for this analysis the time for the height changing was recorded. The experiment setup was set as same as the previous analysis. The same five people were used to do this test. Each of the person was stand in front of the

rostrum, and the rostrum started to move vertically up. A stop watch was used to record the time taken for the distance change. The stop watch was started when the rostrum is started to move up and the watch was stopped when the camera detected face presence and the rostrum stopped. Figure 4.14 shows the position of user in front of the rostrum.

Figure 4.14: The standing position of human in front of rostrum.

The height changes and the time taken to move from one point to another was recorded in Table 4.6. Besides that, some calculation was been done to identify the average speed of the motor. The calculated speed for each test and the total average speed of the motor was tabulated as shown in Table 4.6.

Table 4.6: Result of the Height vs Time test

People With Diff. Height	Height of the Rostrum (cm)			Time Taken (s)
	Original	Stopped	Difference	
Person A	103	108	5	2.54s
Person B	103	111	8	4.11s
Person C	103	120	17	8.63s
Person D	103	124	21	11.11s
Person E	103	129	26	13.47s

The recorded data in the Table is helpful to find the speed of the motor which used in the rostrum. The formula Distance (m) / Time taken (s) is used to calculates the speed of the motor for each of the person's test, and the calculated speed and the total average speed were recorded in Table 4.7

Table 4.7: Speed of the motor

People with Different Height	Speed of the Motor (m/s)
Person A	0.05 ÷ 2.54 = **0.0197 m/s**
Person B	0.08 ÷ 4.11 = **0.0195 m/s**
Person C	0.17 ÷ 8.63 = **0.0197 m/s**
Person D	0.21 ÷ 11.11 = **0.0189 m/s**
Person E	0.26 ÷ 13.47 = **0.0193 m/s**
Average	**0.0194 m/s**

Graph and bar chart were plot based on the data in the tables above. The first graph in Figure 4.15 is about the difference of the height from original position to the stopped position versus the time take to move from the original position to the stopped

position. While the second bar chart in the Figure 4.16 is about the speed of the motor which is calculated by using the data of the test.

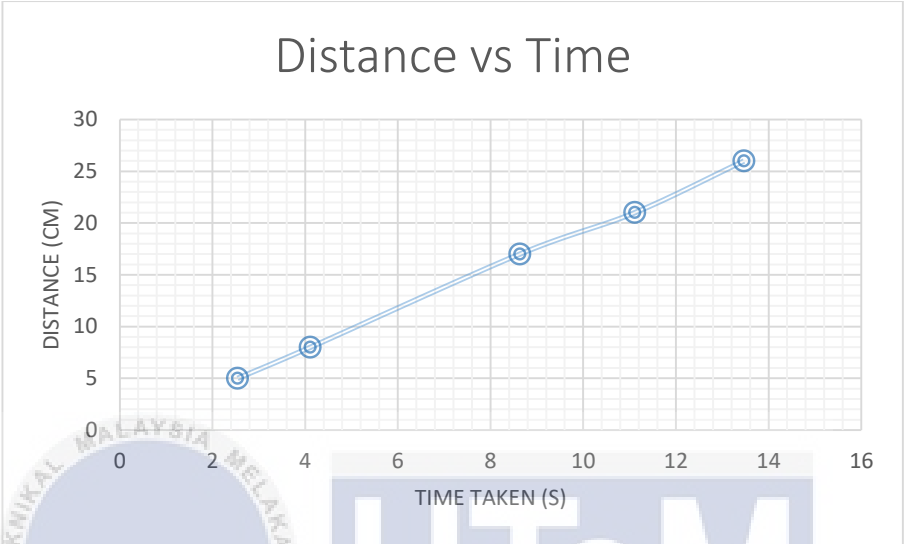


Figure 4.15: Graph of Distance vs Time

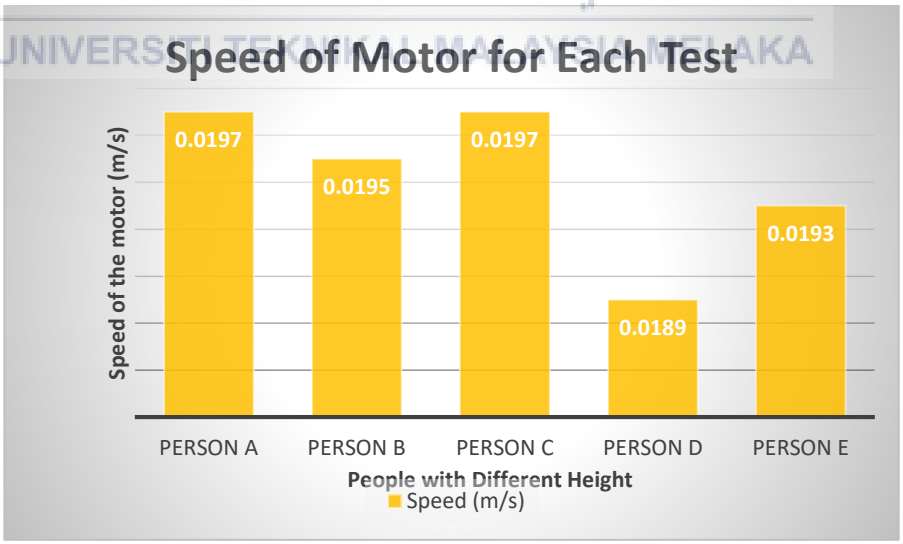


Figure 4.16: Bar chart for speed of the motor for five persons test

The average speed of the motor was calculated as shown in Table 4.7. The average speed for the motor which used in this rostrum is as shown in the Figure 4.17.

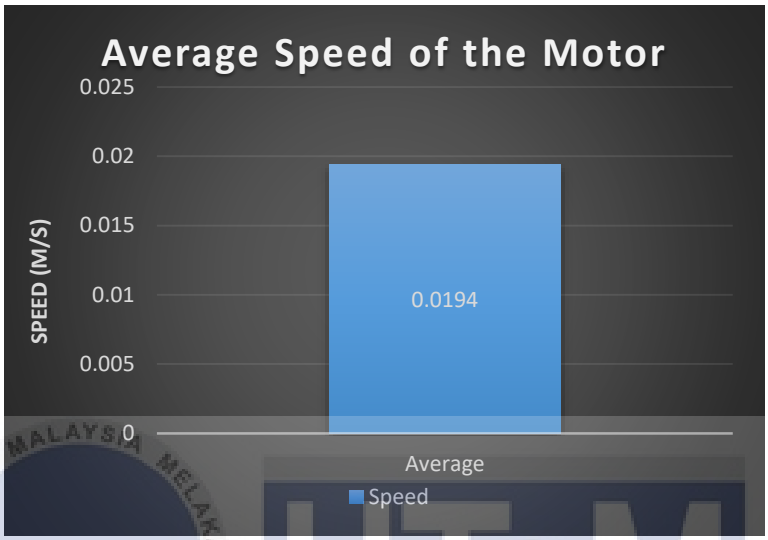


Figure 4.17: Bar Chart of the Average Speed of the Motor

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, the objective for final year project to design an automated rostrum with face detection system is achieved where the design was designed based on the criteria and the designing methods. This finalised design was been used for the fabrications process. Besides that, face detection system is very important in order to make the height adjustment of the rostrum, so as a 1st step the face detection system was created by using the OpenCV library in Raspberry pi and Pi camera. After successfully created the system, the system was test to analyse the face detection accuracy.

The second objective which is develop the automation system of rostrum by using face detection system also is achieved where the system was created using an Arduino controller to control the movement of the motor. The signals from the Arduino is send to the relay module which I known as a motor drove. The relay module is the main part which is control the direction of the motor, so when the relay receives signal from the Arduin, relay make the motor to move. This automation system was developed by connecting the face detection system into this automation system. In this process the face detection is acting more likely as a face detecting sensor, so when the camera detect the presence of human face than the Raspberry Pi sends signal to the Arduino and the motor stop rotates. This is how the automation system was developed

by using the face detection system. Lastly, the third objective is also have been achieved which is to analyse the efficiency of the automated rostrum with Face detection system. To achieve this objective there were five analysis made to check the efficiency of the Automated Rostrum with Face Detection system.

The first analysis was made on accuracy of the face detection system, this analysis was made to check on how accurate the system work on detecting human face. Secondly, analysis of light intensity versus face detection accuracy. This analysis was done to check the accuracy of the face detection system d different lighting. This helps to identify the suitable place to use the rostrum whether in indoor, outdoor or both. The third analysis was analysis of camera positioning. The camera position in the rostrum is very important, because the camera will be detecting the presence of human face so the placement of the camera was need to be analyse.

The next analysis was, analysis for height accuracy. This height accuracy test was repeated for 5 times to check the accuracy of the height in all five test. Last but not least, analysis of height versus time. The last analysis was really helpful to identify the speed of the motor after full fabrication was done. All the data and result of the analysis was recorded, tabulated and plotted as graph.

5.2 Future Recommendation

This current implementation has weakness where difficult to move from one place to another. The design of the rostrum is very important, to make this rostrum easily to move from one place to another, should upgrade the design. When its come to design the stability of the design is also the main part should be concern. This current implementation has the limitation of the height is 103cm minimum, this minimum limit is mostly suitable for the people who are more than 170cm height, for those who

are less than 170cm they will be uncomfortable to use the rostrum. The minimum and maximum height can be change or modify in future. Besides that, currently the push button is been used to activate the system, to make the full system more automatically an ultrasonic sensor or some other sensor can be used to detect human presence, and then start the system with face detection. The sensor should send signal to the controller and Raspberry pi to start detecting face and to start the motor rotating. Thus, the weakness faced in this current implementation could be compensated.

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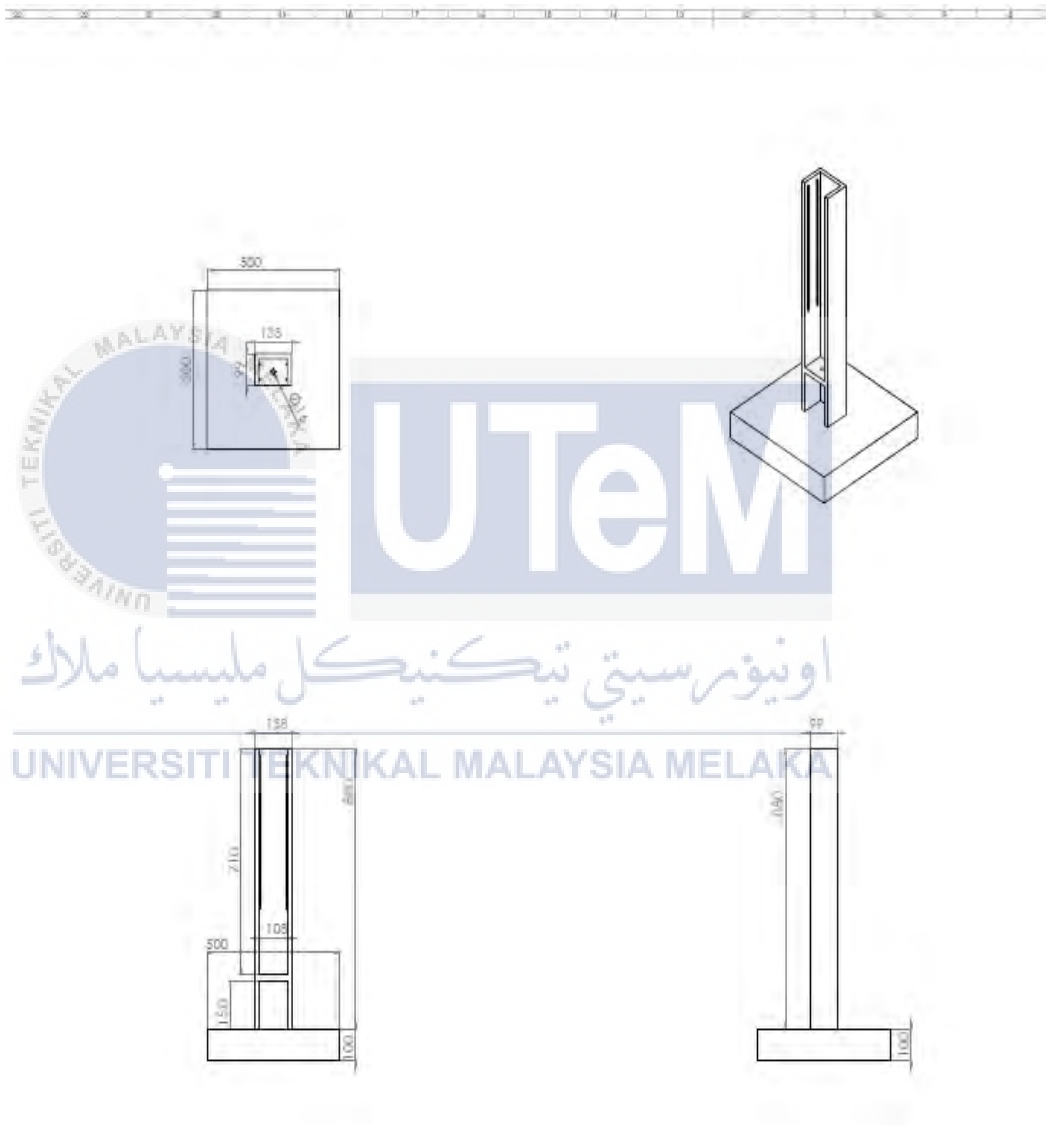
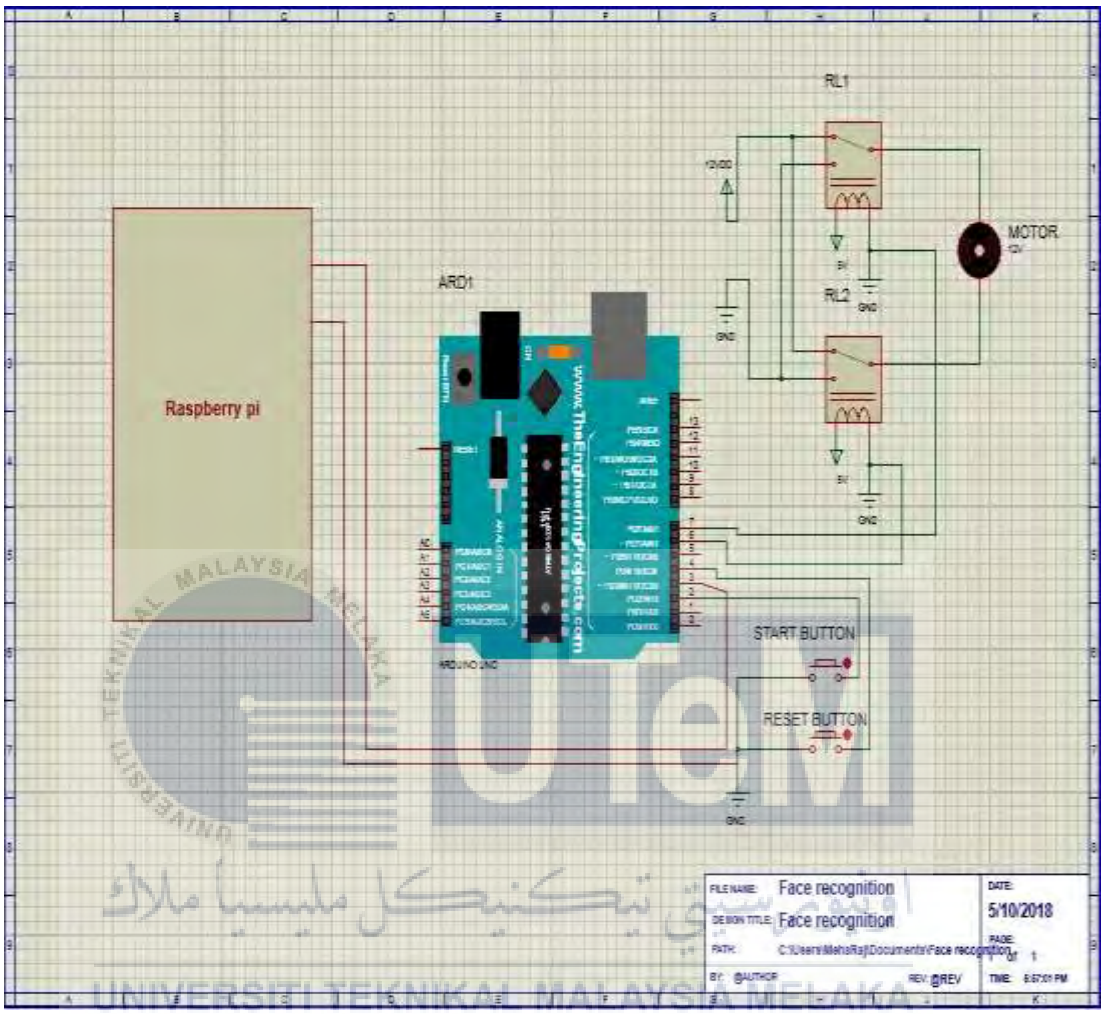
APPENDIX



Bottom Part of designed Rostrum

Top part of the designed Rostrum



Circuit Design of Arduino

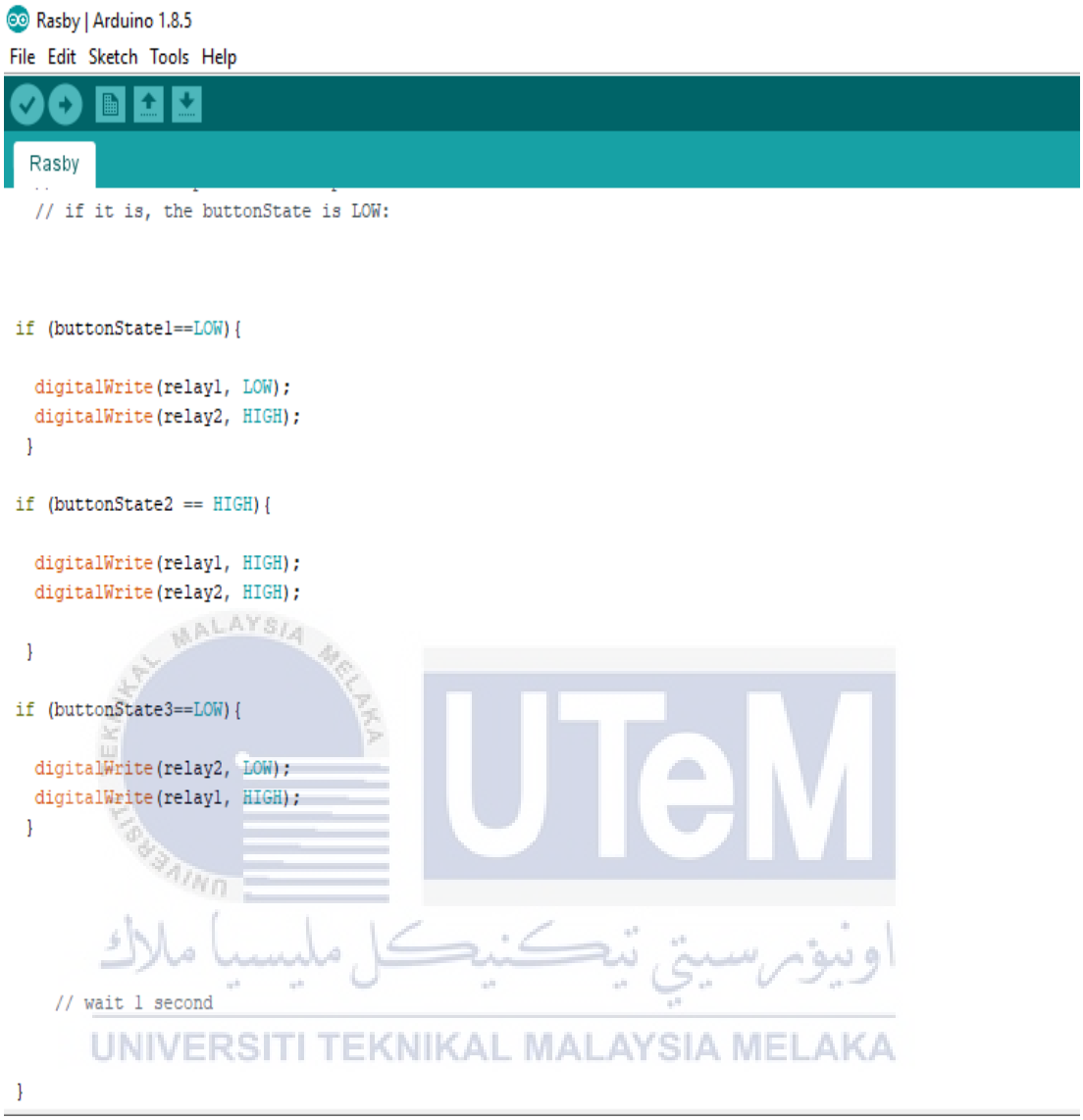
Rasby | Arduino 1.8.5

File Edit Sketch Tools Help

Rasby

```
const int button1 = 2;
const int button2 = 3;
const int button3 = 4; // the number of the pushbutton pin
const int relay1 =  11;            // the number of the relay1 pin
const int relay2 =  12;            // the number of the relay1 pin

int buttonState1 = 0;
int buttonState2 = 0; // variable for reading the pushbutton1 status
int buttonState3 = 0;

void setup() {
                                   // initialize the relay pin as an output:
  pinMode(relay1, OUTPUT);
  pinMode(relay2, OUTPUT);


  // initialize the pushbutton pin as an input:
  pinMode(button1, INPUT_PULLUP); // PULLUP for add 5v to pin without hardware prevent pin from floating between HIGH and LOW
 pinMode(button2, INPUT_PULLUP);
  pinMode(button3, INPUT_PULLUP);
    digitalWrite(relay1, HIGH);
   digitalWrite(relay2, HIGH);
}

void loop() {
  // read the state of the pushbutton value:
  buttonState1 = digitalRead(button1);
  buttonState2 = digitalRead(button2);
  buttonState3 = digitalRead(button3);
  // check if the pushbutton is pressed.
```


Coding for Arduino (1)



Coding for Arduino (2)