UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN
MALAYSIAN SPANISH INSTITUTE
(UNIKL- MSI)

MINI PROJECT
(DC Motor Controller)

SAB35403 - PCB DESIGN

PREPARED FOR: DR MOHD REZAL BIN MOHAMED

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Table of Contents

ABSTRACT

This project is to design a DC Motor Controller circuit using Orcad Capture and Orcad Layout Plus software. The design process encompasses various stages, including schematic design, circuit layout, component placement, and generating Gerber files. This report outlines the application of PCB design techniques, development of the PCB circuit, and preparation of a comprehensive technical report.

1.0 INTRODUCTION

The DC Motor Controller serves as a crucial component in various applications, regulating the speed and direction of DC motors. This project focuses on designing a PCB layout for a DC Motor Controller using Orcad Capture for schematic design and Orcad Layout Plus for PCB layout.

2.0 OBJECTIVES

- To apply PCB design process techniques using CAD software.
- To develop PCB circuit using CAD software and generate the Gerber files.
- To prepare a comprehensive technical report based on typical engineering report guidelines.
- To foster teamwork effectively in a group while preparing business plans to produce economically PCB design.

3.0 METHODOLOGY

1. Schematic Circuit Design
   Utilized Orcad Capture to create a detailed schematic circuit for the DC Motor Controller, incorporating essential components such as resistors, capacitors, transistors, and the DC motor.

2. Circuit DRC (Design Rule Check)
   Performed a thorough DRC to ensure the schematic design adheres to standard design rules, including clearance, trace width, and component spacing.

3. Circuit Netlist CreatioN
   Generated a circuit netlist from the schematic design, capturing the connectivity information of the components.

4. Layout Circuit Design
   Transitioned to Orcad Layout Plus to create the physical layout of the PCB circuit, ensuring optimal component placement and routing.

5. New Footprint Creation
   Designed custom footprints for specific components to ensure accurate representation and compatibility with the PCB layout.

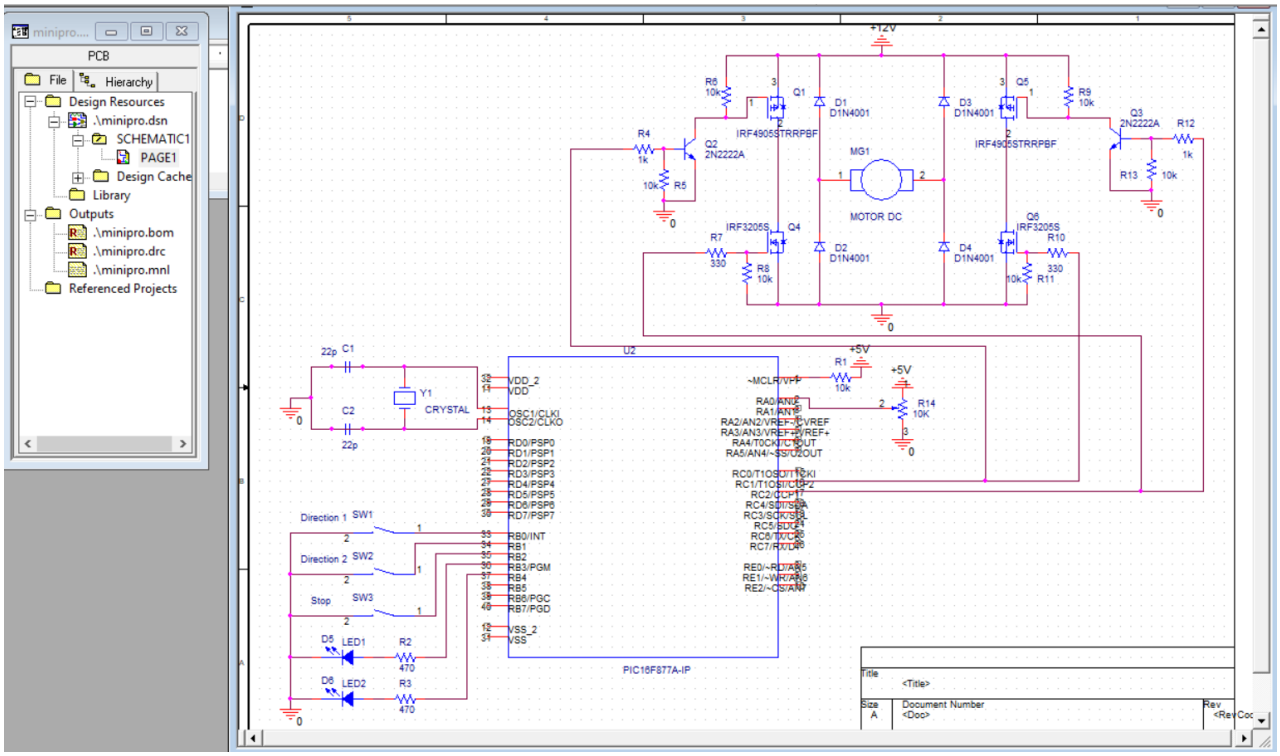
6. Board Outline and Component Arrangement
   Established the board outline and strategically arranged the components within the layout, considering functionality, space constraints, and signal integrity.

7. PCB Routing
   Employed both auto-routing and manual routing techniques to establish electrical connections between components while minimizing signal interference and ensuring manufacturability.

8. PCB Configuration
   Configured the PCB circuit as a two-sided design, optimizing the layout for efficient manufacturing and assembly processes.

9. Gerber Files Generation
   Generated Gerber files from the finalized PCB layout, ensuring compliance with manufacturing specifications and standards.

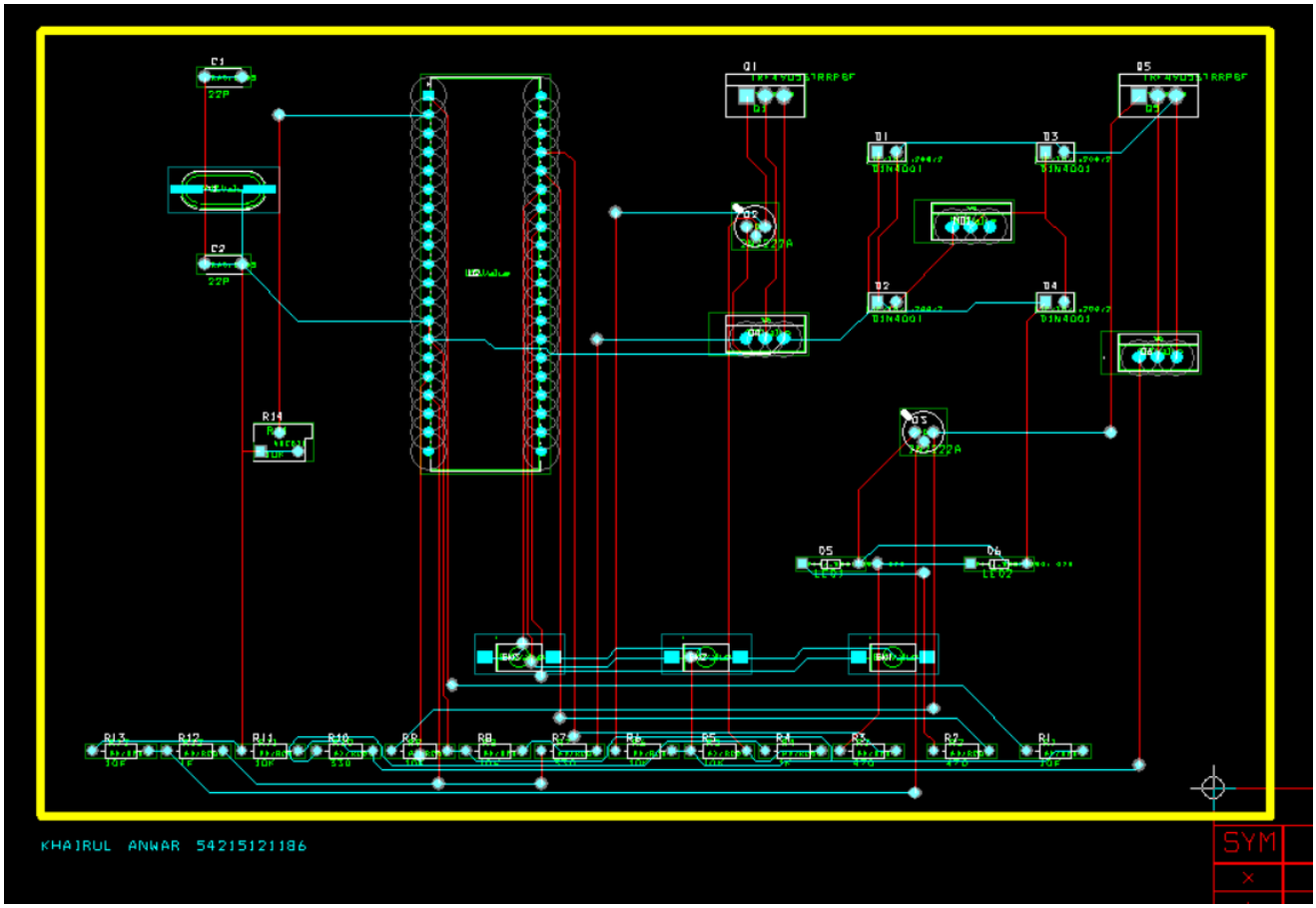
4.0 SCHEMATIC CIRCUIT



PART PROPERTIES FOOTPRINT NAME

		Value	Reference	Primitive	Name	Power Pins Visible	PCB Footprint
1	SCHEMATIC1 : PAGE1 : Y1	CRYSTAL	Y1	DEFAULT	I29014		ABLS2_Series_ABR
2	SCHEMATIC1 : PAGE1 : U2	PIC16F877	U2	DEFAULT	I02337		PDIP40_600MC_MCH
3	SCHEMATIC1 : PAGE1 : SW3	Stop	SW3	DEFAULT	I06230		SWITCH_FSMSM_TY
4	SCHEMATIC1 : PAGE1 : SW2	Direction 2	SW2	DEFAULT	I06202		SWITCH_FSMSM_TY
5	SCHEMATIC1 : PAGE1 : SW1	Direction 1	SW1	DEFAULT	I04107		SWITCH_FSMSM_TY
6	SCHEMATIC1 : PAGE1 : R9	10k	R9	DEFAULT	I04391		AX/RC05
7	SCHEMATIC1 : PAGE1 : R8	10k	R8	DEFAULT	I04369		AX/RC05
8	SCHEMATIC1 : PAGE1 : R7	330	R7	DEFAULT	I04347		AX/RC05
9	SCHEMATIC1 : PAGE1 : R6	10k	R6	DEFAULT	I04325		AX/RC05
10	SCHEMATIC1 : PAGE1 : R5	10k	R5	DEFAULT	I04303		AX/RC05
11	SCHEMATIC1 : PAGE1 : R4	1k	R4	DEFAULT	I04281		AX/RC05
12	SCHEMATIC1 : PAGE1 : R3	470	R3	DEFAULT	I04259		AX/RC05
13	SCHEMATIC1 : PAGE1 : R2	470	R2	DEFAULT	I04237		AX/RC05
14	SCHEMATIC1 : PAGE1 : R14	10K	R14	DEFAULT	I05500		VRES10
15	SCHEMATIC1 : PAGE1 : R13	10k	R13	DEFAULT	I04479		AX/RC05
16	SCHEMATIC1 : PAGE1 : R12	1k	R12	DEFAULT	I04457		AX/RC05
17	SCHEMATIC1 : PAGE1 : R11	10k	R11	DEFAULT	I04435		AX/RC05
18	SCHEMATIC1 : PAGE1 : R10	330	R10	DEFAULT	I04413		AX/RC05
19	SCHEMATIC1 : PAGE1 : R1	10k	R1	DEFAULT	I04215		AX/RC05
20	SCHEMATIC1 : PAGE1 : Q6	IRF3205S	Q6	DEFAULT	I16307		TRANS_IRF3710PBF
21	SCHEMATIC1 : PAGE1 : Q5	IRF4905ST	Q5	DEFAULT	I31559		TO220AB
22	SCHEMATIC1 : PAGE1 : Q4	IRF3205S	Q4	DEFAULT	I01107		TRANS_IRF3710PBF
23	SCHEMATIC1 : PAGE1 : Q3	2N2222A	Q3	DEFAULT	I00953		TO18
24	SCHEMATIC1 : PAGE1 : Q2	2N2222A	Q2	DEFAULT	I00927		TO18
25	SCHEMATIC1 : PAGE1 : Q1	IRF4905ST	Q1	DEFAULT	I31114		TO220AB
26	SCHEMATIC1 : PAGE1 : MG1	MOTOR D	MG1	DEFAULT	I00905		TRANS_IRF3710PBF
27	SCHEMATIC1 : PAGE1 : D6	LED2	D6	DEFAULT	I24667		DAX1/.300X.050/.02
28	SCHEMATIC1 : PAGE1 : D5	LED1	D5	DEFAULT	I24224		DAX1/.300X.050/.02
29	SCHEMATIC1 : PAGE1 : D4	D1N4001	D4	DEFAULT	I01045		DO-41
30	SCHEMATIC1 : PAGE1 : D3	D1N4001	D3	DEFAULT	I01023		DO-41
31	SCHEMATIC1 : PAGE1 : D2	D1N4001	D2	DEFAULT	I01001		DO-41
32	SCHEMATIC1 : PAGE1 : D1	D1N4001	D1	DEFAULT	I00979		DO-41
33	SCHEMATIC1 : PAGE1 : C2	22p	C2	DEFAULT	I04547		RAD/CK05
34	SCHEMATIC1 : PAGE1 : C1	22p	C1	DEFAULT	I04525		RAD/CK05

5.0 PCB CIRCUIT



LAYER SPREADSHEET

Layers

Layer Name	Layer Hotkey	Layer NickName	Layer Type	Mirror Layer
TOP	1	TOP	Routing	BOTTOM
BOTTOM	2	BOT	Routing	TOP
GND	3	GND	Plane	(None)
POWER	4	PWR	Plane	(None)
INNER1	5	IN1	Unused	(None)
INNER2	6	IN2	Unused	(None)
INNER3	7	IN3	Unused	(None)
INNER4	8	IN4	Unused	(None)
INNER5	9	IN5	Unused	(None)
INNER6	Ctrl + 0	IN6	Unused	(None)
INNER7	Ctrl + 1	IN7	Unused	(None)
INNER8	Ctrl + 2	IN8	Unused	(None)
INNER9	Ctrl + 3	IN9	Unused	(None)
INNER10	Ctrl + 4	I10	Unused	(None)
INNER11	Ctrl + 5	I11	Unused	(None)
INNER12	Ctrl + 6	I12	Unused	(None)
SMTOP	Ctrl + 7	SMT	Doc	SMBOT
SMBOT	Ctrl + 8	SMB	Doc	SMTOP
SPTOP	Ctrl + 9	SPT	Doc	SPBOT
SPBOT	Shift + 0	SPB	Doc	SPTOP
SSTOP	Shift + 1	SST	Doc	SSBOT

6.0 BILL OF MATERIAL

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 8:
 9:
10: Bill Of Materials        January 10,2024      19:15:10  Page1
11:
12: Item    Quantity    Reference    Part
13: ____________________________________________________
14:
15: 1    2    C2,C1    22p
16: 2    4    D1,D2,D3,D4 D1N4001
17: 3    1    D5  LED1
18: 4    1    D6  LED2
19: 5    1    MG1 MOTOR DC
20: 6    2    Q1,Q5    IRF4905STRRPBF
21: 7    2    Q2,Q3    2N2222A
22: 8    2    Q6,Q4    IRF3205S
23: 9    8    R1,R5,R6,R8,R9,R11,R13, 10k
24:           R14
25: 10   2    R3,R2    470
26: 11   2    R12,R4   1k
27: 12   2    R7,R10   330
28: 13   1    SW1 Direction 1
29: 14   1    SW2 Direction 2
30: 15   1    SW3 Stop
31: 16   1    U2  PIC16F877A-IP
32: 17   1    Y1  CRYSTAL
33:
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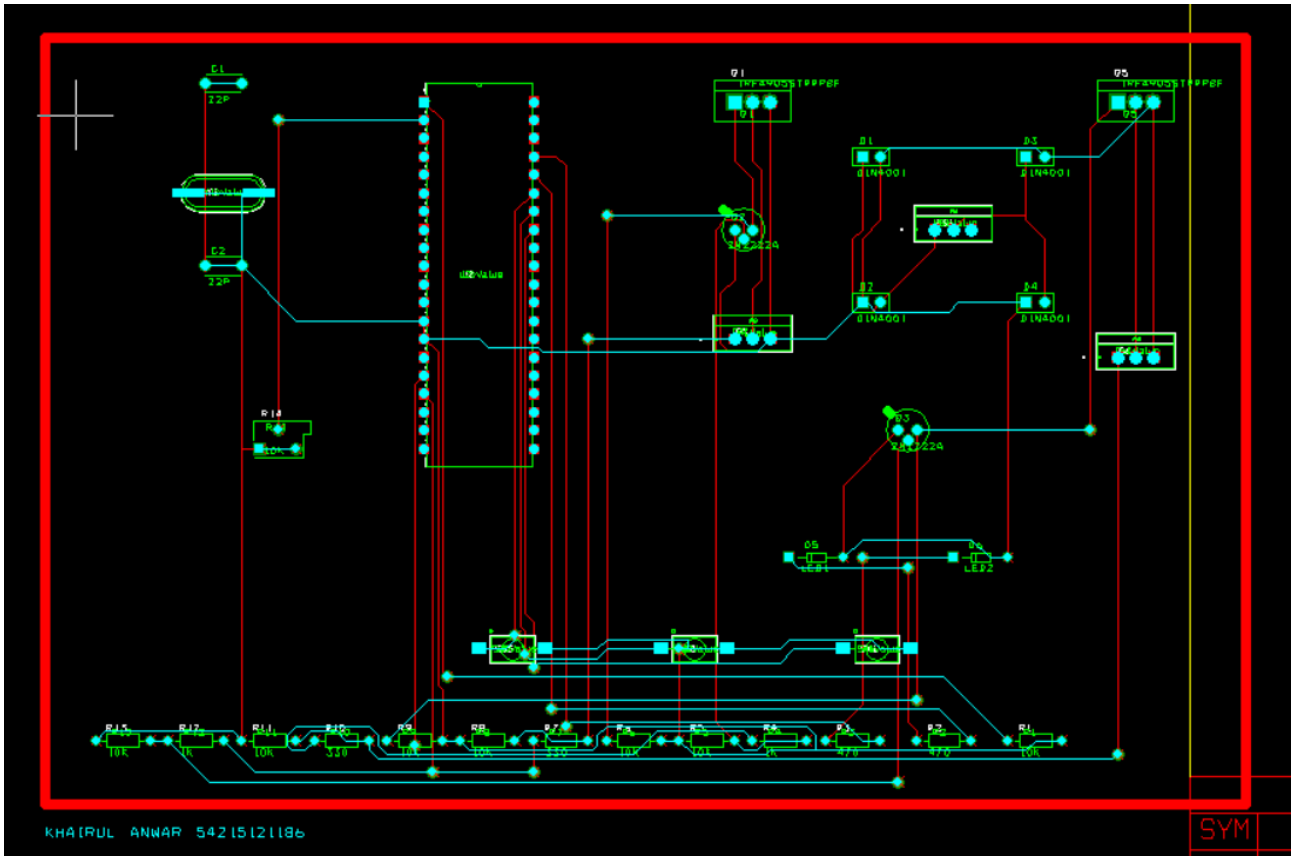
No	Component	Quantity	Price
1	Capacitor 22pF	2	
2	Diode	4	
3	Led d5	1	
4	Led d6	1	
5	Motor dc	1	
6	NPN TRANSISTOR (2N2222A)	2	
7	IRF4905STRRPBF	2	
8	IRF3205S	2	
9	Resistor 10k ohm	8	
10	Resistor 470 ohm	2	
11	Resistor 1k ohm	2	
12	Resistor 330	2	
13	Switch direction 1	1	
14	Switch direction 2	1	
15	Switch stop	1	
16	PIC16F877A	1	
17	CRYSTAL	1	
	TOTAL		<RM1500

7.0 GERBER FILES



8.0 RESULT AND DISCUSSION

The design process yielded a functional and optimized PCB layout for the DC Motor Controller, demonstrating proficiency in using Orcad Capture and Orcad Layout Plus software. Key outcomes and observations include:

- Successful application of PCB design techniques, fulfilling the specified course learning outcomes.
- Development of a robust and efficient PCB circuit layout tailored for controlling a DC motor.
- Compliance with design rules, standards, and best practices to ensure reliability, performance, and manufacturability.
- Effective utilization of CAD software capabilities for schematic design, layout, component placement, routing, and Gerber file generation.

9.0 CONCLUSION

The design of the DC Motor Controller using Orcad Capture and Orcad Layout Plus exemplifies a systematic approach to PCB design. By adhering to established methodologies, standards, and best practices, a functional and optimized PCB layout was achieved. This project reinforces the importance of CAD software proficiency, design validation, collaboration, and continuous improvement in PCB design processes and outcomes.

10.0 RECOMMENDATION

- Further optimization of component placement and routing techniques for enhanced performance and efficiency.
- Continuous learning and exploration of advanced features and functionalities within Orcad Capture and Orcad Layout Plus software.
- Collaboration with manufacturing and assembly teams to ensure seamless transition from design to production while considering cost-effective strategies.