INDUSTRIAL MOTOR CONTROL: A TECHNICAL FEASIBILITY STUDY

LEUMARDO P. BOBIS

Cavite State University (Main Library)



T5907

THESIS/SP 621.8 B63 1994

Maddin balledi at School and Independent Maddidge Moset March INDUSTRIAL MOTOR CONTROL:
A TECHNICAL FEASIBILITY STUDY

A Thesis

Presented to

the Faculty of the Graduate School

Marikina Institute of Science and Technology

Marikina, Metro Manila

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts in Teaching



LEONARDO P. BOBIS April, 1994

ABSTRACT

In line of vision Philippines 2000, this technical feasibility study aimed to discover if it is feasible to design and construct an industrial motor control for instructional purposes in electrical technology at Valeriano E. Fugoso Memorial School, Boystown, Marikina, Metro Manila, Division of City Schools, Manila.

The study is centered in the designing, constructing, testing and revising control model using the modern products and local materials. It would be a great help in providing adequate instructional equipment for laboratory activities and improve technical skills of students in electrical technology at Valeriano E. Fugoso Memorial School.

The significant findings in the discovery of the study is technically feasible to construct an instructional model an industrial motor control. It shows that the control model could perform various functions of basic motor starting such as: direct-on-line starting, star-delta starting, automatic and reversing star-delta starting and liquid level control operation. This model is similar to the controls utilized in commercial and industrial establishments, liquid plant industry, and other form of electrical machineries. The modern equipment of the control model is available for construction that has a long life span and simple in maint-

enance. The electrical coenections, diagrams, and symbols are based on the American and European standards. The production cost is \$31,198.00 compared to the assembled unit of commercial product of more than \$73,000.00.

The capability of effectiveness, functionality, and safety for electrical controls proves the result of this study, furthermore, it reveals that the students could easily comprehend the competency of the control model.

TABLE OF CONTENTS

																		Page
TITL	E PAGE		3	, ,	5 •	•	•	•	•	•	•	•	•	•	•	•	:•	i
AFPRO	OVAL SHEET		•	•		•	•	•	•	•	•	•	•	•	•	•	•	ii
ACKNO	OWLEDGMENT	• • •	• •			٠	•	•	•	•	•	•	•	•	•	•	i.	jii
ABST	RACT	• •	•	•		•	•	•	•	•	•	•	•	•	٠.			vi
TABLE	E OF CONTE	ENTS .	•	•		•	•	•	•	•	•	•	•	•	•	•	i" •	viii
LIST	OF TABLES		• •		• •	• ,	• .	•	•	•		•	•	•	•	•	•	x
LIST	OF FIGURE	S	•	•	• •	.•	•	•	•	•	•	•	•	•	•	•	•	, xi
Chap	ter				,													
1	INTRO	DUCT IO	١,	•		•	•		•	•	•	•	•	•	•			1
	Α.	Origi	n ar	nd J	iust	if	ica	ati	.on	. 0	f	tŀ)e	S	tuc	γt	•	1
	В.	Objec	tive	es c	of t	he	St	ud	ÌУ	•	•	•	•	•	•	•	•	2
	С,	Scope	and) De	elim	ita	ati	ion	1	•	•	•	•	•	•	•	•	2
2	CONC	EPTUAL	FRA	MEW	ORK	•	•	•	•	•	•	•	•	•	•		•	3
	Α,	Review Stud	v of	Re	lat.	ed •	Li	te.	ra	tu	re	e a	·	•				3
	В.	Conce	o tu a	al M	lode	1		•	•	•	•	•	•	•	•	•	•	12
	С.	Defin in						.ca						• •		•		13
3	DEVEL	OPMENT	OF	THE	PR	OJE	ECT	•	•		•	•	•	. •	•		.	15
	Α.	Suppl	ies	and	l Ma	tei	ria	als	;			•	•	•	•		i. •	15
	В.	Tools	anc	B Eq	uip	mer	nt	•			_			_		-	÷	1Ω

Chapter				Page
	С.	Consumption Procedure	; •	19
	D.	Tryout and Revision	·	32
	E.	Construction Time Frame	i.	32
	F.	Production Cost	•	36
4	DESCR	RIPTION OF THE COMPLETED PROJECT	•	43
	Α.	Structure	•	43
		 Parts and their Functions Interrelationship of the Parts Capabilities Limitations 		43 53 57 70
	В.	Process		70
		 Operating Procedure Maintenance Safety and Control Measures 	•	70 72 80
5	SUMMA	ARY, CONCLUSION, AND RECOMMENDATIONS .		81
	Α.	oummary	•	81
	В.	Conclusion	• •	82
	C.	Recommendations	, i,	82
BIBLIOGR	ALHY.		. 1.	84
APPENDIX				86
CURRICUL!	IIV MI	ГАЕ	1	87

LIST OF TABLES

Table	Page
1	Electrical Supplies and Materials 15
2	Table and Panelboard Supplies and Materials . 16
3	Miniature Water Tank Supplies and Materials . 17
4	Tools and Equipment and their Respective Functions
5	Defects Found and Revision Made
6	Work Activities and Time Allotment
7	Electrical Supplies and Materials and Cost 🐍 30
8	Donated Electrical Supplies and Materials and Cost
9	Panelboard Supplies and Materials and Cost 🐍 38
10	Panelboard Table Supplies and Materials and Cost
11	Miniature Water Tank Supplies and Materials and Cost
12	Sources of Cost to Cost
13	Cost to Cost of Electrical Control System Model

LIST OF FIGURES

Figure		Page
1	Styrax Colporation, Showcase U.S.A., January/February 1986	6
2	Del Fackaging Inc. Showcase U.S.A., January/ February 1986	8
3	Angstrom Technologies, Circle No. 153 on Action Land	8
4	Conceptual Model	12
5	Panelboard and Table Form Measurement	21
6	Mounting Electrical Components and Devices $\tilde{\zeta}$	23
6. 5	Installing Banana Jacks According to their Various Arrangement and Position	23
6.9	Soldering Pair of Installed Banana Jacks	24
7	Soldering Banana Plugs	25
8	Different Lengths of Connecting Wires	26
9	Preparation for Wiring Installation and Connection	28
loA	A Method of Using VOM for Shorts	29
loB	Shows Another Method of Testing Components for Continuity and Open Circuits	29
10C	A Method of Testing Components for Grounds	30
1OD	A Method of Using a Snap-Around Type Volt- Ammeter-Ohmeter Tester	30
11	A Constructed Mini-Water Tank	31
12	First Revision of Industrial Motor Control	33
13	Final Revision of Industrial Motor Control	35

Figure	Paç	је
14	A Complete Set of Instructional Model (Industrial Motor Control)	11
15	A Panelboard Table	14
16A	A Panelboard with Electrical Components and C-trim Support	45
16B	A Fanelboard with Components Symbol	45
17	A Group of Installed Banana Jacks	46
18	A Knife Switch and Voltmeter	48
19	A Pilot Lamps, Pushbutton Station	48
20	A Magnetic Contactors	50
21	A Timing Relay Overload Relay and Liquid Level Relay	50
22A	A Fractional Horsepower Size Three-Phase Motor	52
22B	A Six Leads out of Three-Phase Motor	52
23	A Paradigm of Interrelationship of the Parts.	54
24A	A Complete Set of Diagrams for Water Pump Control in a Star-Delta Starting	55
24B	A Complete Set of Diagrams for Water Pump Control Using Direct-on-Line Starting	58
25	An American Wiring Diagram Symbols	59
26	An European Control Devices Wiring Symbols ,	63
27	An European Switchgear Wiring Symbols	61
28	Control Circuit Devices for Direct Motor Starters	62
29	Direct-on-Line Starting of Three-Phase Motors Circuit Control Diagram Reversing	5 3

Figure	P	age
30	Direct-on-line Starting of Three-Phase Motors Power Circuit Diagram	64
31	Direct-on-Line Starting of Three-Phase Motors with Bridging of Overload Relay Luring Starting	65
32	Direct-on-Line Starting of Three-Phase Motors Power Circuit Diagram with Bridging of Overload Relay During Starting	66
33	Direct-on-Line Starting of Three-Phase Motors Control Circuit Diagram	67
34	Direct-on-Line Starting of Three-Phase Motors Power Circuit Diagram	68
35	An American Direct-on-Line Starter with Power and Control Circuit Diagram	69
36	An American Star-Delta Starter with Power and Control Circuit Diagram	73
37	Automatic Star-Delta Starters with Overload Relay	74
38	Star-Delta Starting of Three-Phase Motors Power Circuit Diagram	75
39	Star-Delta Starting of Three-Phase Motors Control Circuit Diagram Reversing	76
40	An American Reversing Star-Delta Starter with Power and Control Circuit Diagram	7 7
41	Reversing Star-Delta Starting of Three- Phase Motor Power Circuit Diagram	78
42	Reversing Star-Delta Starting of Three- Phase Motors Control Circuit Diagram	7 9

Chapter 1

INTRODUCTION

This chapter presents the origin and justification, objectives of the study, and scope and delimitation of the study.

A. Origin and Justification of the Study

Science and technology are rapidly changing. They are leaping and bouncing through its latest modern sophisticated machines. They brought social and economic development commonly in the industrial technology. The Philippines, a developing country in Asean nations, are focusing the trends of latest technology. Regarding this rapid changes, the government launched the visions/objectives. "Philippines 2000" as one of the newly industrialized country.

Technical and vocational institutions are greatly affected, requiring high technology equipment for highly technology skills and training of technician instructors. Hence, financial support is required due to the inadequacy of training facilities and equipment. As a prime mover for high technology, new training/program must be adopted for technical manpower development to the students in order to meet the manpower need of industries and a productive citizen of the newly industrialized country.