



Bahria University
Discovering Knowledge

FINAL YEAR PROJECT REPORT

**MINIMIZING ELECTRICITY THEFT USING
INTERNET OF THINGS**

By

SYED IBRAHIM KHALIL

(43711)

MEHROZ AHMAD

(43767)

SUPERVISED BY

(DR. SYED SAFDAR ALI RIZVI)

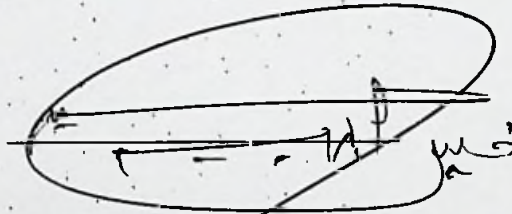
BAHRIA UNIVERSITY (KARACHI CAMPUS)

2019

DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

Signature :



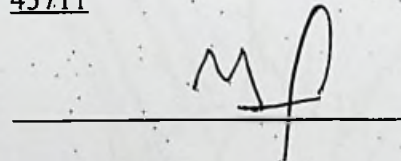
Name :

Syed Ibrahim Khalil

Reg No. :

43711

Signature :



Name :

Mehroz Ahmad

Reg No. :

43767

Date :

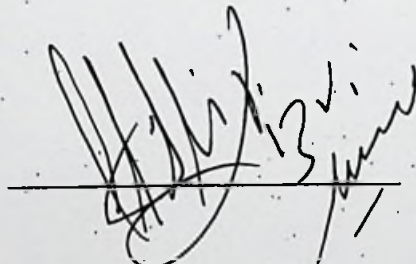
16th Dec, 2019

APPROVAL FOR SUBMISSION

I certify that this project report entitled "**MINIMIZING ELECTRICITY THEFT USING INTERNET OF THINGS**" was prepared by **SYED IBRAHIM & MEHROZ AHMAD** have met the required standard for submission in partial fulfillment of the requirements for the award of Bachelor of Computer Science (Honours) at Bahria University.

Approved by,

Signature



Supervisor : Dr. Syed Safdar Ali Rizvi

Date : 16th Dec, 2019

ACKNOWLEDGEMENTS

1

We would like to thank everyone who had contributed to the successful completion of this project. We would like to express my gratitude to my research supervisor, Dr. Syed Safdar Ali Rizvi for his invaluable advice, guidance and his enormous patience throughout the development of the research.

In addition, we would also like to express my gratitude to our loving parent and friends who had helped and given me encouragement.

MINIMIZING ELECTRICITY THEFT USING INTERNET OF THINGS

ABSTRACT

Electricity theft is one of the major issues for a country as well as a critical problem for electricity companies which faces huge amount of loss daily because of it. To provide a solution to this problem, the concept of SMART GRID is introduced, using latest cloud connectivity. Smart Grid provides two-way communication between supply and consumption of electricity, which would be viable to identify theft easily. We have made cost-effective cost effective monitoring devices that are connected to NAN network, a small network consisted of automesh devices that sends up its monitored readings to Amazon Web Services (AWS) cloud, which is then passed through "MQTT-Topics", rules and Lambda function to Losant IoT Enterprise, for visualization, potential theft identification and analysis.

TABLE OF CONTENTS

DECLARATION	ii
APPROVAL FOR SUBMISSION	iii
ACKNOWLEDGEMENTS	vi
ABSTRACT	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF SYMBOLS / ABBREVIATIONS	xvii

CHAPTER

INTRODUCTION	18
1.1 Background	18
1.2 Problem Statement	19
1.3 Aims and Objectives	20
1.4 Scope of Project	20
LITERATURE REVIEW	21
2.1 Electricity Generation	21
2.2 Electricity Consumption	22
2.3 Smart Grid	22
2.3.1 Concept of Smart Grid	23
2.3.2 Smart Infrastructure	24
2.3.1 Data Concentrator	24

2.4	Power Theft	25
2.4.1	Line Tapping	26
2.4.2	Un-Metered Connections	26
2.4.3	Unpaid Bills	26
2.4.4	Meter Tampering	27
2.4.5	Resolving Power Theft	31
2.4.6	Power Meters in Pakistan	35
2.4.7	Power Meters in First World Countries	36
2.5	Energy Monitoring	37
2.6	LoraWan	37

DESIGN AND METHODOLOGY 38

3.1	Proposal to Minimize Electricity Theft	38
3.2	Internet of Things	39
3.3	IoT Architecture	41
3.4	Energy Monitoring	42
3.4.1	ESP32 Microcontroller	42
3.4.2	Current Transformer	43
3.4.3	Wiring	43
3.4.4	Device Creation	44
3.5	Cloud & Gateway	44
3.5.1	IoT & Cloud Architecture	45
3.5.2	AWS	46
3.5.3	Losant	52
3.6	Data Analytics	52
3.6.1	Microsoft Power BI	53
3.7	Methodology	54

1

IMPLEMENTATION 60

4.1	Network Address Translation (NAT)	60
4.1.1	Automesh	62
4.2	AWS	63
4.2.1	Setting Up Device	63

		x	
	4.2.2	Creating Lambda Function	66
4.3		Losant	71
	4.3.1	Device Connectivity	71
	4.3.2	Data Collection And Visualization	72
	4.3.3	Device Creation	72
	4.3.4	Workflows	75
	4.3.5	Webhook	85
	4.3.6	Data Table	86
4.4		POWER BI	87
	4.4.1	Getting Started	88
4.5		Result	91
	4.5.1	DATA GRAPH	91
	4.5.2	Dashboards	94
 CONCLUSION AND RECOMMENDATION			 99
5.1		Smart Grid Benefits	99
5.2		Future Scope	100
	5.2.1	Industrial CT	100
	5.2.2	Extended Range of Repeaters	101
	5.2.3	Zigbee	102
	5.2.4	Integration of multiple CT's	104
 REFERENCES			 106
 APPENDICES			 109
 APPENDIX A: Graphs			 109
 APPENDIX B: Computer Program Listing			 118
 APPENDIX C: Calibration			 126