

استهلال

قال تعالى:

(...يرفع الله الذين آمنوا منكم و الذين أوتوا العلم درجات و الله بما تعملون
خبير(11))

سورة المجادلة

صدق الله العظيم

DEDICATION

This project is dedicated to...

Our beloved parents for their love, endless support,
and encouragement

Our teachers who guided through this path of learning
toward success

And to those who accompanied us in the path of
friendship

ACKNOWLEDGMENT

We are thankful to almighty Allah, most Gracious, who in His infinite mercy has guided us to complete this project.

Special thanks to our supervisors Ayman Makawi and Dr.Rania, for the supervision and constant support.

Their invaluable help of constructive comments and suggestions throughout the experiment. Special thanks to Dr.Alaa Eldin Awoda.

Abstract

The weather has always been a subject of universal interest, and the recent climate change issue. Thus, the main objective of this thesis a foundation is laid for a low cost, energy efficient and a fully automatic weather station. The novelties of the station are its ability to acquire weather data automatically and send it via the GSM network to a communication server. It includes most common weather sensing options and good accuracy. The station is comprised of several components that, when assembled, are called an embedded system. Its main components are an Arduino microcontroller, a GSM communication module and weather sensors. The station's main requirements and specifications of components are analyzed. Suitable and task specific components are compared to find the most appropriate ones for the system.

المستخلص

لطالما كانت حالة الطقس محط اهتمام الناس حول العالم, خصوصا بعد التغيرات المناخية الأخيرة. لذلك فان الهدف الاساسي لهذا المشروع هو عمل محطة ارساد جوية باقل تكلفة و اعلى جودة و تعمل اوتوماتيكيا. مميزات هذه المحطة هي القدرة على قراءة حالة الطقس و ارسالها الى خادم كل ما توفرت شبكة انترنت لنقل البيانات. هذه المحطة تتضمن معظم الحساسات الشائعة و بدقة عالية في القراءة. المحطة تتكون من مكونات عندما تجمع سويا يطلق عليها اسم نظام مدمج. العنصر الاساسي في المحطة هو الاردوينو و نظام الاتصالات GSM و الحساسات. متطلبات المحطة الاساسية تم تحليلها و عناصر المشروع تمت مقارنتها للوصول لافضل عناصر لاستخدامها.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	استهلال	i
	DEDICATION	ii
	ACKNOWLEDGMENT.....	iii
	Abstract.....	iv
	المستخلص	v
	List of tables.....	x.
	List of figures.....	..xi
	Abbreviation.....	xii
1	INTRODUCTION	2
1.1	Introduction	2
1.2	Problem statement.....	5
1.3	Proposed solution.....	5
1.4	Objectives.....	5
1.5	Methodology.....	5
1.6	Thesis outlines.....	6
2	LITERATURE REVIEW.....	9
2.1	Back ground.....	9

2.1.1 Embedded Systems.....	9
2.1.2 Microcontroller.....	9
2.1.3 Microprocessor.....	10
2.1.4 Arduino.....	11
2.1.5 Sensors.....	12
2.1.5.1 Rain gauge sensor.....	13
2.1.5.2 Temperature sensor.....	14
2.1.5.3 Wind Sensors	18
2.1.5.4 Humidity Sensor.....	21
2.1.5.5 Pressure Sensor.....	21
2.1.6 GPRS.....	22
2.1.7 Protocol.....	22
2.1.8 Power supply.....	24
2.2 Related works	25
2.3 Field visit.....	30
2.3.1 Types of weather stations.....	30
2.3.2 Power efficiency.....	31
2.3.3 Stations of the center.....	31
2.3.4 Center stations' problems.....	31

3	METHODOLOGY.....	35
3.1	Sensors.....	35
3.1.1	Temperature and humidity.....	35
3.1.2	Pressure sensor.....	37
3.1.3	Ultrasonic wind sensor.....	39
3.1.4	Rain gauge sensor	40
3.2	Seeeduino GPRS.....	41
3.3	MQTT Protocol.....	42
3.3.1	Publish/Subscribe.....	43
3.3.2	Client.....	44
3.3.3	Broker.....	45
3.3.4	MQTT Connection.....	45
3.3.5	Topics.....	45
3.3.6	Quality of Service.....	46
3.4	System scenario.....	47
3.5	System Flow Chart.....	48
3.6	System Block Diagram.....	49
4	SIMULATIN AND HARDWARE.....	52
4.1	Simulation.....	52

4.1.1 Pressure Sensor.....	52
4.1.1 Temperature and Humidity Sensor	53
4.1.3 Rain Gauge Sensor.....	54
4.1.4 Wind Sensor.....	55
4.2 Hardware.....	56
4.2.1 Temperature and humidity measurement	56
4.2.2 Pressure measurement.....	57
 5 CONCLUTION AND RECOMMENDATION.....	62
5.1 Preface.....	62
5.2 Conclusion	63
5.3 Recommendation.....	64
 REFERENCES.....	65

List of Tables

TABLE NO.	TITLE	PAGE
Table 2-1:	Overview and comparison of different temperature sensor technology.....	18
Table 3-1:	Prosperities of the DHT11 humidity sensor.....	35
Table 3-2:	Prosperities of the DHT11 temperature sensor.....	36
Table 3-3:	Cable connections between DHT11 Breakout and Seeeduino.....	36
Table 3-4:	Prosperities of the BMP180 pressure sensor.....	38
Table 3-5:	Cable connections between BMP180 Breakout and Seeeduino GPRS.....	38

List of Figure

FIGURE NO.	TITLE	PAGE
	Figure 2-1: general block diagram of CPU (Microprocessor).....	10
	Figure 2-2: Types of microcontroller.....	11
	Figure 2-3: Graduated cylinder rain gauge sensor.....	13
	Figure 2-4: Tipping bucket rain gauge sensor.....	15
	Figure 2-5: Weighing rain gauge sensor.....	15
	Figure 2-6: Optical rain gauge sensor.....	16
	Figure 2-7: A cup anemometer.....	19
	Figure 2-8: An aero-vane is a combination of a propeller anemometer and a tail-vane wind direction meter.....	20
	Figure 2-9: A sonic anemometer.....	20

Figure 2-10: a tail vane used to measure wind direction.....	21
Figure 2-10: Concept of Internet of Things.....	23
Figure 2-11: Types of weather station.....	30
Figure 2-12: AWS box containing battery and GSM module.....	31
Figure2-13: VISALA automatic station.....	31
Figure 3-1: Overall communication process.....	37
Figure 3-2: Seeeduino GPRS.....	42
Figure 3-3: MQTT Publish/Subscribe.....	44
Figure 3-4: MQTT Connection.....	45
Figure 3-5: System Flow Chart.....	48
Figure 3-6: System Block Diagram.....	49
Figure 3-6: System Block Diagram.....	49

Figure 4-1: Pressure sensor readings.....	53
Figure 4-2: Temperature sensor readings.....	53
Figure 4-3: Humidity sensor readings.....	54
Figure 4-4: Tipping buckets rain gauge sensor.....	54
Figure 4-5: Ultrasonic anemometer.....	55
Figure 4-6: DHT11 connected with seeeduino GPRS.....	56
Figure 4-7: Displaying temperature and humidity readings.....	57
Figure 4-8: BMP180 connected to the seeeduino GPRS.....	58
Figure 4-8: Displaying pressure and altitude readings.....	58