AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer and Systems Engineering

Design and Implementation of Wireless Electrocardiography (ECG) Monitoring System

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Electrical Engineering

(Computer and Systems Engineering)

by

Ahmed Mohamed Hussein Ahmed Aboalseoud

Bachelor of Science in Electrical Engineering

(Communication Systems Engineering)

Credit Hours Engineering Programs, Faculty of Engineering, Ain Shams University, 2013

Supervised By

Prof. Ayman Mohamed Mohamed Hassan Wahba

Dr. Mohamed Ahmed Mohamed El-Nozahi

Dr. Ahmed Mohamed Ibrahim Hassan El-Rafei

February 2020

Cairo, Egypt

Acceptance on Master Degree

Faculty of Engineering

Computer and Systems Engineering

Design and Implementation of Wireless Electrocardiography (ECG) Monitoring System

Prepared by:

Ahmed Mohamed Hussein Ahmed Aboalseoud

Examiners' Committee

Name	Signature
Prof. Ahmed Mohamed El-Bialy **Systems and Biomedical Engineering, Cairo University**	.....
Prof. Hani Fikry Ragaai **Electronics & Electrical Communication Engineering, Ain Shams University**	.....
Prof. Ayman Mohamed Mohamed Hassan Wahba **Computer and Systems Engineering, Ain Shams University**	.....

...../...../.....

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Computer and Systems Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Student name: Ahmed Mohamed Hussein Ahmed Aboalseoud

Signature

……...…….

Researcher Data

Name: Ahmed Mohamed Hussein Ahmed Aboalseoud

Date of birth: 01-Dec-1990

Place of birth: Cairo, Egypt

Last academic degree: B.Sc. in Electrical Engineering

Field of specialization: Communication Systems Engineering

University issued the degree: Credit Hours Engineering program, Ain Shams University

Date of issued degree: June 2013

Current job: Testing/Application Engineer at Analog Devices, Inc.

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer and Systems Engineering

Thesis title: **Design and Implementation of Wireless Electrocardiography (ECG) Monitoring System**

Submitted by: **Ahmed Mohamed Hussein Ahmed Aboalseoud**

Degree: **Master of Science in Computer and Systems Engineering**

Thesis Summary

With the increasing interest about healthcare, more people desire to check their health conditions frequently. Home healthcare electronic devices enable patients to monitor their vital signals. Electronic measurement of ECG faces many challenging problems such as the electric field interference, low ECG amplitude and motion artifacts due to the patient movements. An on-body wireless sensor network is used for monitoring the ECG signals from the human body. This thesis demonstrates a new application for the wireless domain to improve the home healthcare of patients. Home healthcare electronic devices, which enable patients to test, monitor ECG continuously, and treat certain healthcare conditions are becoming an important aspect of healthcare. The main difference between this system and the existing ones is that the electrodes themselves are communicating with a base station in a wireless fashion, thus providing better

mobility for the patient. In this thesis, the techniques for motion artifacts reduction are explored for a wireless sensor system for ECG monitoring.

This thesis is divided into 5 chapters:

1. Introduction
2. Background and Literature survey on wireless systems for ECG monitoring architectures
3. System design and simulation for the wireless sensor system top level architecture
4. Circuit design, simulation for the sensor interface front end building blocks and System implementation and testing
5. Conclusion

Keywords:

Telemedicine, Electrocardiogram (ECG), accelerometer, real-time monitoring, single lead, adaptive filter, motion artifacts, body sensor network

Acknowledgment

I am very grateful to Allah, for letting me finish this thesis and with it my MSc degree. I would like to thank Prof. Hani Ragaai and Dr. Mohamed El-Nozahi for allowing me to join their research group. And for their continuous guidance, mentoring and patience with me. I would like specially to thank my supervisors, Dr. El-Nozahi and Dr. Ahmed Ibrahim, for their continuous inspiration and encouragement on this work. It has been a valuable experience to work with them.

I thank my fellow colleagues at ASU, they helped me a lot whether technically by advising me and having good discussions. I would like to thank Eng. Akram Youssry for his continuous support.

At the end, I would like to share this joy with my family members and friends. My parents and parents-in-law, your support and prayers all the time made this task easier. My brother, sisters and brothers-in-law, your advices and encouraging words were the reminder to continue this work. My wife and son to whom this dissertation is dedicated, thank you for your love, support and cheering me up whenever I was down.

This project is funded by National Telecom Regulatory Authority (NTRA) in Egypt.

CONTENTS

Contents

LIST OF FIGURES

List of Figures

List of Figures

List of Figures

LIST OF TABLES