بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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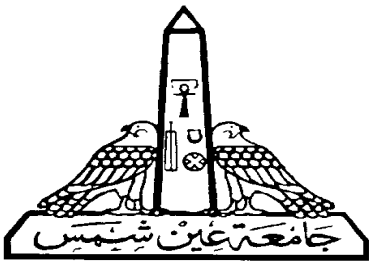

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Design and Implementation of Non-invasive Vital Patient Data Acquisition Technique Using IoT Technology

A thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science in Electrical Engineering

(Computer Engineering and Systems)

by

Mahmoud Mohamed Salama Salem

Bachelor of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

Thebes High Institute of Engineering, 2014

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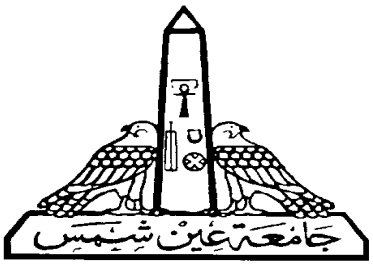
Cairo - (2020)



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Date: 6 September 2020

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering 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.

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ABSTRACT

The rapid development of technology has brought about a revolution in healthcare bringing about a wide range of smart and autonomous applications in clinics, surgeries and hospitals. Smart healthcare opens the opportunity for a qualitative advance in the relations between healthcare providers and end-users for the provision of health care, such as; enabling doctors to diagnose remotely while optimising the accuracy of the diagnosis, and maximising the benefits of treatment by enabling close patient monitoring.

This thesis reports the successful development of a non-invasive vital data acquisition algorithm designed to combine with an IoT algorithm for healthcare solutions. The device is able to collect, handle, process and analyse human vital signs via non-invasive methods. Such a device should enable the reduction of infection.

The IoT communication algorithm has a network of four nodes: one for heartrate measurement and another for body temperature, and another for vital data visualisation. The fourth node is a Broker node. This delivers a real-time exchange of vital signs/data without latency. In particular, an embedded software design offers a reliable solution to optimise communication time and provide a real time response for nodes issues. In addition, the design of the mesh (IoT) network was developed for heterogeneous physical layers which are able to communicate at dual-frequencies and varying distances. The software was designed to interface easily with nodes that could be added in the future to increase the scale of IoT mesh.

Keywords:

Healthcare System, Vital Signs, Vital Data, Non-invasive Data Acquisition, Internet of Things (IoT), Machine-to-Machine (M2M) Communication, Vital Signs, Wireless Sensor Network (WSN), Digital Image Processing, and Computer Vision.

Thesis Summary

In this thesis, the author proposes a new design for a heterogeneous IoT communication network based on convenient algorithms. This network structure has been developed to include four node complexity and cloud communication. Also, the author has designed and developed a non-invasive data acquisition algorithm based on computer vision in order to estimate heartrate as a vital sign. Moreover, the author designed and developed an embedded systems algorithm to sense human body temperature (the second vital sign) via a non-invasive sensor. The integration of the three algorithms offer affordable, stable, real-time, and accurate solution for vital data monitoring. It is an important feature of the system that it is fully non-invasive, which has the important benefits of reducing cross-infection and increasing the system's usability. Additionally, the proposed IoT algorithm permits parallel processing of vital data and synchronisation of information. This system has been developed not only for hospital use but also to be convenient for use in homes, nursing homes, schools, and working environments.

In particular, data is acquired via a computer vision algorithm in order to be work fully non-invasive. This algorithm captures a frame which is processed to extract the user's (human patients including children) heartrate. An infrared sensor extracts the body temperature non-invasively. The IoT is integrated to process the two algorithms for vital data acquisition via these two nodes and provides a third node to visualise the vital data. Finally, the fourth and last IoT node is the Broker which provides real-time synchronisation of data exchange through all nodes and cloud computing.

This work is presented in the five following chapters, organized as:

Chapter One: Introduction to the thesis with discussion of challenges, problem definition, and the proposed solution.

Chapter Two: Introduces the state-of-the-art of the Internet of Things and vital data acquisition.

Chapter Three: Contains the architecture, design and implementation of the proposed algorithms.

Chapter Four: Presents the results of the proposed solution in comparison with related work.

Chapter Five: Concludes the thesis and suggests future work.

Keywords:

Healthcare System, Vital Signs, Vital Data Acquisition, Bio-Sensing, Non-invasive Data Acquisition, Internet of Things (IoT), Machine-to-Machine (M2M), Wireless Sensor Network (WSN), Computer Vision, Heartrate (HR), Body Temperature (BT).

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