

Sudan University of Science and Technology College of Engineering Electronics Engineering School



Simulation of human prosthetic arm

A Research Submitted In Partial fulfillment for the Requirements of the Degree of B.Sc. (Honors) in Electronics Engineering

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Dedication

For those whom inspired us to do this thesis, who are struggling life to live it the way they want, not the way they can. To reach decent life to themselves and others surrounding them, to those who don't make handicaps a factor of discrimination.

It is presented to all families, the true blessing from god into our lives. To teachers and doctors who were the definition of beacons in our search for knowledge. Sudan University of science and technology entire staff.

We expand our gratitude to the University of Medical Science and Technology crew for their great help. Last but not least to the special person who dedicated his time and knowledge to make this possible, the one and only Dr. AlaEldin Awouda.

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All praise due to Allah, the all mighty god, who spread his and wisdom across the globe, all our thanks to our lord.

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Abstract

Abstract

The human prosthetics is a major lack in our surrounding, while the technical capabilities are capable for its availability. Thus a control system for a prosthetic human arm that functions by mirroring the movements of an existing arm is the aim of this project. An arm that reflects the other one to make daily tasks easier for the amputees, with the capability of sensing excess heat and force applied on it to offer protective reaction. This thesis uses electrodes sensors to sense the different moves of the arm. The signals from electrodes through a pickup circuit will be passed to microcontroller to translate those signals to the motors. A programmed microcontroller is used to control the behavior of the arm. Different sensors are used to sense different physical signals such as temperature and force. According to the signals from those sensors the microcontroller will control the arm. The simulation for the system carried a fair degree of freedom for shoulder, elbow and wrist joints, to simulate the mirroring of the movements. The obtained result from the simulation is encouraged for more research in this area.

المستخلص

الأطراف الصناعيه البشريه هي نقص كبير في محيطنا, في حين أن القدرات التقنيه قادره على توفيرها. وبالتالي نظام تحكم لليد الصناعيه البشريه الذي يعمل عن طريق عكس حركة يد موجوده هو الهدف من هذا المشروع. يد تقوم بعكس الأخرى لجعل المهام يوميه أسهل لمبتوري اليد, مع قدرة الإستشعار للحراره الفائضه و القوه المطبقه عليها لتقديم رد فعل وقائي. هذه الأطروحه تستخدم مستشعرات الإلكترود لإستشعار المحركات المختلفه لليد. الإشارات من الإلكترود عبر دائرة التقاط ستمرر الى المتحكم الدقيق لترجمة تلك الإشارات للموتور. متحكم دقيق مترجم مستخدم للتحكم في سلوك اليد. مختلف المستشعرات مستخدمه لإستشعار مختلف الإشارات الفيزيائيه مثل الحراره والقوة. تبعا للإشارات من تلك المستشعرات المتحكم الدقيق سيتحكم في اليد. المحاكاة للنظام تحمل درجه عادله من الحريه للمفاصل الكتف, المرفق و المعصم, المحاكاة انعكاس الحركات. النتيجه المتحصله من المحاكاة قابله لمزيد من الدراسه في هذا المجال.

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List of abbreviations:

ADC : Analog to digital convertor

ADCSRA : Analog to Digital Converter Control

Statues Register

ADSC : Analog to Digital Converter Start

Conversion.

ADEN : Analog to Digital Converter Enable

ADATE : Analog to Digital Converter Auto

Trigger Enable

ADHSM : Analog to Digital Converter High

Speed Mode

ADLAR : Analog to Digital Converter left Adjust

Result

ADMUX : Analog to Digital Converter

Multiplexer.

ADIF : Analog to Digital Converter Interrupt

Flag.

ADIE : Analog to Digital Converter Interrupt

Enable.

AVR : Advanced Virtual RISC.

AREF : Analog Reference

ADPS2 : Analog to Digital Converter Prescaler

Select Bits

ALU : Arithmetic Logic Unit

ATMAGA16 : Atmel 16 Mega

CICS : Complex Instruction Set Computer

CPU : Central Processing Unit

CMOS : Complementary Metal-Oxide

Semiconductor

CMR : Common Mode Rejection

EEPROM : Electric Erasable Programmable Read

Only Memory

EMG : Electromyography

GND : Ground

ISP : IN System Programmer

PIC : Peripheral Interface Controller

RISC: Reduced Instruction Set Computer

SPI : Serial Peripheral Interface

|--|

USART : Universal Synchronous Asynchronous Receiver/Transmitter

Chapter One

Introduction

Chapter one Introduction.

1.1 Background

Arm loss is a tragic case and it happens for many reasons, illness war or even accidents. Humans through history tried to reach a substitute to that part to make the individual able to look or function similar to normal.

As the technology evolution the traditional arm is no longer enough and below the needed tasks at capability limits, thus a modern function arm that can work as a replace for the lost arm and do moves based on nerves bases, which are to get the needed functionality on more of a natural form.

Prosthetics is part of the field of bio mechatronics, which aims to integrate mechanical, electrical and biological systems. They are typically used to replace appendages lost to injury, missing from birth, or to replace a defective body part. Prosthetics are important to improve amputees' lifestyles and in order to do so there have been many studies aimed at allowing control over the prosthetic appendage. In this report we will look at a myoelectric-controlled prosthetic hand.

The aim is to develop a prosthetic arm which can be controlled by signals from a set of muscles in the body using EMG signal, the arm will have a functional elbow, wrist and shoulder with two functions, the first function is to simulate the other arm of the user and the second is to sense the excess pressure and heat and make a reaction based on pre stored signals.

1.2 Problem Statement

The arm loss is a huge life changing experience, which makes life harder for the individual and limits the level of self-independency of any human, and as well may cause of harm or the inability to avoid danger. In Chapter one Introduction.

general life, many simple tasks become impossible for the human to do, such as lifting an object.

Old methods used a static prosthetic made of wood or metal, with evolution new light and strong fabrics appeared, yet that all was just a regular looks matter.

1.3 Proposed Solutions

To use myoelectric in designing an automatic control system and this system will be controlled by a microcontroller.

With technology evolution new changes were added, the microcontrollers and microcomputers are now available and with high performance range, motors and sensors, the sensors are great key in the prosthetic evolution. The ability of having a prosthetic arm that is able to function and to make moves based on natural responses (more than forced), and this would make a great help in the prosthetics evolution and it's affectivity in the daily life of humanity.

1.4 Research Aims and Objectives

Aims:

- To develop a hand that mirror's the move of the existing other hand.
- To get the hand to be able to interrupt the mirroring function for another robotic movement such as danger avoidance.

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Objectives:

- To proposed control system development.
- To simulate the proposed control system.
- To evaluate the proposed control system.
- To design the system.

1.5 Scope

This covers reading muscle signals and processing of this signal, sensing, programming the microcontroller using specific code and designing the arm using motors.

1.6 Methodology

The methodology used to accomplish the required objectives can be divided into three phases or stages.

- First stage: sensing and reading EMG (electromyography) signal, then amplify the signal so it can be readable by the micro-controller.
- Second stage: control the obtained signal from the first stage and the sensors using micro-controller.
- Third stage: finalization of the stages, using the output of the previous stage in the control of motors movement.

<u>Chapter one</u> <u>Introduction.</u>

1.7 Research Outlines

- Including this chapter the research includes another five :-
- Chapter two the literature reviews of the previous work and the history of the development done in the project's field, as well as the used components main description.
- Chapter three provides detailed description of the microcontroller, since it's the main control of the system.
- Chapter four the design is described for the technical aspect.
- Chapter five illustrates the simulation and results gained out of the project, as well explains the mechanism of operation.
- Chapter six the conclusion of the research and the recommendations for the progress and enhancement of the research.