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ABBREVIATIONS

Abbreviation	Synonym
A2	Aortic component of second heart sound
ADC or A/D	Analog to digital converter
ADCSRA	Analog to Digital converter Control and Status Register A
A-V	Atrio-Ventricular
CPU	Central processing unit
dB	Decibel
DC	Direct Current
DLL	Dynamic-link library
DMA	Direct memory access
DSP	Digital signal processing
EC	Ejection click
ECP	Extended capabilities port
EEPROM	Electrically Erasable Programmable Read-Only Memory
EPP	Enhanced parallel port
FFT	Fast Fourier transform
FIFO	First in first out
F _s	Sampling Frequency
HES	Heart energy signature
HostAck	Host Acknowledge
HostClk	Host Clock
Hz	Hertz (Cycle / minute)

I/O	Input / Output
IrDA	Infrared Data Association
ISA	Industry Standard Architecture
ISR	Interrupt service routine
LPC	Linear prediction coding
LSB	Least significant bit
μ s	Micro second
ms	milli second
m/sec	Meter / second
MHz	Mega hertz
mV	milli volt
op amp	Operational amplifier
OS	Opening snap
P2	Pulmonic component of second heart sound
PC	Personal computer
PDS	Power density spectrum
PeriphAck	Peripheral Acknowledge
PeriphClk	Peripheral Clock
PS/2	Simple bidirectional port
S1	First heart sound
S2	Second heart sound
S3	Third heart sound
S4	Fourth heart sound

SCSI	Small Computer System Interface
Seg.	Segment
SPP	Standard parallel port
SRAM	Static Random Access Memory
STD	Standard of deviation
STFT	Short Time Fourier Transform
TFR	Time-Frequency Representation
USART	Universal Synchronous and Asynchronous serial Receiver and Transmitter
USB	Universal Serial Bus

ABSTRACT

Using acoustic stethoscope is not efficient always because of the limited sensitivity of the human ear in addition to the noise and artifact. This fact led to the invention of the electronic stethoscope.

In this thesis an electronic stethoscope has been designed and implemented to process, analyze and record heart sounds in real time. This will help in auscultation and diagnosis. Two types of designs are introduced. The first was microcontroller based electronic stethoscope, while the other was PC based electronic stethoscope.

A system of algorithms for analysis of heart sounds has been applied using time-frequency representations. This system performs calculations to obtain some parameters that give useful indicators and help in diagnosis. The algorithms calculate the timing of heart sound components, the duration of each of them, and their energy then plot their spectrogram. The sound components include first heart sound, second heart sound and abnormalities like murmur.

These algorithms have been applied on normal and abnormal heart sounds in some Sudanese specialized hospitals.

The designed electronic stethoscope gave good and valuable results in recording and analysis of heart sounds.

المستخلص

ليست السماعه الطبيه السمعيه كفوءه دائما بسبب الحساسيه المحدوده للأذن البشريه بالإضافة إلى تأثيرات الضوضاء والأخطاء المضافة . هذه الحقيقه أت إلى اختراع السماعه الطبيه الإلكترونيه.

في هذه الأطروحه تم تصميم وتنفيذ سماعه طبيه الكترونيه لمعالجه وتحليل وتسجيل أصوات القلب في الوقت الحقيقي، و هذا سيساعد في الاستماع والتشخيص.

تم تقديم نوعين من التصاميم، الأول سماعه الكترونيه باعتماد المتحكم الدقيق بينما كان الثاني سماعه الكترونيه باعتماد الحاسوب الشخصي.

تم تطبيق نظام من الخوارزميات لتحليل أصوات القلب باستخدام تمثيلات الزمن مع التردد . يقوم هذا النظام بالحسابات للحصول على بعض العوامل التي تعطي المؤشرات المفيدة و تساعد في التشخيص.

تقوم الخوارزميات المطبقة باحتساب توقيتات مكونات صوت القلب، مدة كل منها، وطاقتها ثم القيام برسم المخطط الطيفي لها. تتضمن مكونات صوت القلب: الصوت الأول للقلب، والصوت الثاني للقلب، و الحالات غير الطبيعيه كالهيمهه.

تم تطبيق هذه الخوارزميات على أصوات القلب الطبيعيه وغير الطبيعيه في بعض المستشفيات السودانيه المتخصصه.

أعطت السماعه الطبيه الإلكترونيه المصممه نتائج جيده وذات قيمه في تسجيل وتحليل أصوات القلب.