MNCVSM

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What is **MNCVSM**?

Mobile Non-Contact Vital Sign Monitoring



Motivation



Over 450,000 deaths could be prevented with continuous health monitoring

Current health monitoring systems may:

- Require medical professionals for accurate measurements
- Require physical contact with the user that confines the user to one area
- Require active effort from the user
- Provide non-continuous monitoring

Image source: www.moduldiagram.com/ecg-accessories/



Objectives



• Continuously process and transmit vital sign data (heart and respiratory rate)

to a mobile device in real-time

• Display vital sign data in a user-friendly mobile application designed for both

medically and non-medically trained individuals

• Minimize amount of integrated technology



Non-Contact Vital Sign Acquisition

- Receives signal using Doppler radar-based technology
- Builds off of Dr. Zhang's research
- No contact with the patient
- Continuously monitors heart and respiratory rate
- Approved for testing by IRB







Project Needs



- Analog-to-Digital converter
- Microcontroller
- UART connection
- Bluetooth module
- Mobile device





Bluetooth image source: www.telegraph.co.uk/technology/ Devices image: www.broswerstack.com/live

Technical Specifications



Microcontroller Unit Specifications

Feature	Specification
SPI Data Rate	≥ 24 kB/s
Data Processing Ability	dedicated floating-point unit
Power Supply	< 5.0 V
Size	no specific size; should be considered portable

ADC Specifications

Feature	Specification
Bit Resolution	≥ 16 bits
Number of Channels	3 channels
Sampling Rate	≥ 1000 samples/channel/second

Technical Specifications



Bluetooth Module Specifications

Feature	Specification
Data Throughput	≥ 1 Mbps
Inter-device Range	≥ 20 meters
Bandwidth	2.4 GHz
Power Supply	< 5.0 V
Peak Power Consumption	≤ 80 mW
Size	should be no larger than a standard evaluation board

Mobile Application and Device Specifications

Feature	Specification
Operating System	Android 5.0 or greater
Wireless Communication	Bluetooth capable
Display and Plotting Ability	real-time plotting of analyzed data

Component Selection

- STM32F373VCT6 Microcontroller
- STM32F373VCT6 Microcontroller Evaluation Board
- SPBT3.0DP1 Bluetooth Classic Module
- SPBT3.0DP1 Bluetooth Classic Module Evaluation Board
- CON-SMA-EDGE-S Jack Connector
- CCSMA-MM-086-8 Coaxial Cable
- 132169 Coaxial Connector





Images source: www.digikey.com

Prototype Cost



Equipment Costs for Prototype

Product Description	Quantity	Unit Price	Cost
STM32F373VCT6 Microcontroller	1	\$5.81	\$5.81
STM32F373VCT6 Evaluation Board	1	\$248.75	\$248.75
SPBT3.0DP1 Bluetooth Classic Module	1	\$14.10	\$14.10
SPBT3.0DP1 Bluetooth Classic Module Evaluation Board	1	\$47.25	\$47.25
CON-SMA-EDGE-S Jack Connector	4	\$1.74	\$6.96
CCSMA-MM-086-8 Coaxial Cable	4	\$10.68	\$42.72
132169 Coaxial Connector	4	\$5.76	\$23.04
		Total	\$388.63

Design Approach

- 1. Signal processing
- 2. Wireless communication
- 3. Mobile application development
- 4. User interface implementation





Final Demonstration









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Settings

9:00

MNCVSM Breathe Easy

Average: 70 beats per minute

Respiration Rate 🥂

Average: 15 breaths per minute

History

Send

Heart Rate 🤎



Graphs of vital sign history

Current Status



- Product Selection
 - Microcontroller (STMicroelectronics STM32F373VCT6 Microcontroller)
 - Bluetooth module (STMicroelectronics SPBT3.0DP1 Bluetooth Classic)
 - Android version (Android version 5.0)
- Screen layouts for user interface
- Researched
 - Digital Signal Processing Methods
 - Wireless Communication Protocols
- Remaining Decisions

Image source: www.cnet.com/pictures/

Proposed Schedule

Module Schedule



TASKS* *person(s) doing each task TBD	1/7	1/14	1/21	1/28	2/4	2/11	2/18	2/25	3/4	3/11	3/18
Phase II (Spring 2019) Implementation	Phase	II (Sprir	ng 2019) - Imple	ementa	tion					Spring
Preliminary Tasks (Everyone)											Break
MCU Data Acquisition and Processing (Nathanael)											Spring
Wireless Communication (Chelsi)											Break
Mobile App (Ethan, Nydrel, Arianne)											Spring
Testing (Entire System MCU + Wireless Communication + Mobile App)											Break

Preliminary Tasks



TASKS* *person(s) doing each task TBD	1/7	1/14	1/21
Preliminary Tasks (Everyone)			
Proposal Presentation (January 15, 2019)			
Acquire pre-recorded vital sign signals for testing			
Order and wait for parts			

Data Acquisition and Signal Processing



TASKS* *person(s) doing each task TBD	1/14	1/21	1/28	2/4	2/11
MCU Data Acquisition and Processing (Nathanael)					
Determine data processed on MCU versus on mobile device					
Design on-board algorithm to process data					
Test on-board algorithm using a function generator, verify accuracy					
Test on-board algorithm using pre-recorded vital sign signals, verify accuracy					

Wireless Communication



TASKS* *person(s) doing each task TBD	1/14	1/21	1/28
Wireless Communication (Chelsi)			
Connect and Establish a Bluetooth module between the MCU and mobile device		non van verstenen drei greid ve	
Test wireless communication channel, verify accuracy			
Communicate processed or raw data from the MCU to mobile device			

Mobile Application



TASKS* *person(s) doing each task TBD	1/14	1/21	1/28	2/4	2/11	2/18	2/25
Mobile App (Ethan, Nydrel, Arianne)							
Determine Android version to use for mobile application							
Design user interface for mobile device							
Implement user interface design							
Design algorithm to process data sent from the MCU							
Design database for storing vital sign information							
Develop module to plot processed data							
Develop module to initiate vital sign monitoring							
Develop module to save processed data points							
Compile companion mobile application							

Testing



TASKS*	2/10	2/25	24	2/22	2/20
*person(s) doing each task TBD	2/10	2/25	3/4	3/11	3/10
Testing (Entire System MCU + Wireless Communication + Mobile App)					Break
Use pre-recorded vital sign signals, show on mobile device					Spring
Use real-time vital sign signals of volunteer subjects, show on mobile device					Break

Final Deliverables



FASKS* *person(s) doing each task TBD	3/25	4/1	4/8	4/15	4/22	4/29
Phase III (May 2019) Compilation and Presentations	Phase	III Co	ompilati	on and	Present	ations
Compile important results, figures, information, etc.						
Individual Design Notebooks (Phase II and III)						
Design Expo Poster						
Project Website						
Final Presentation						
Final Report						

Thank you

