Non Contact Vital Signs Monitoring System

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Introduction

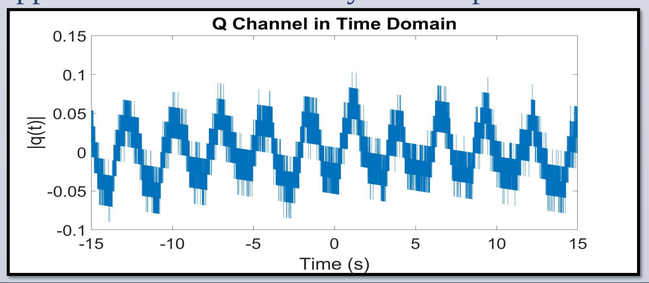
Our team builds upon an existing practical, low-noise detection system that detects vital signs, in order to create a commercial product that is user friendly, can be accessed via a computer user interface (UI) and accurately displays heartbeat and respiration in real-time.

- A microcontroller unit (MCU) samples the signal, and converts the incoming analog signal to digital for transmission to a computer
- The raw digital data is processed to deconstruct the original signal into two separate signals
- The computer UI provides necessary functionality to control the duration of recorded signal and display the incoming raw signal in real-time

Background

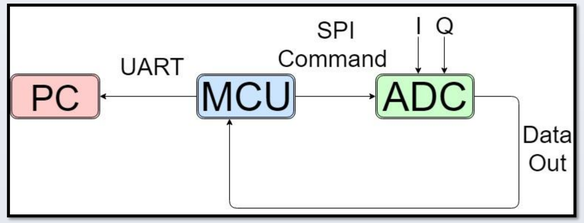
Noncontact vital sign monitoring systems utilize radar signals to determine the frequency and transient features of chest movements.

- The current system setup uses a Doppler radar because of its better system complexity and high distance resolution, and has the capability to extract the frequency and transient vital sign signals
- The most notable difference in design process is the noise suppression scheme to reduce the phase noise of the Doppler radar that has already been implemented

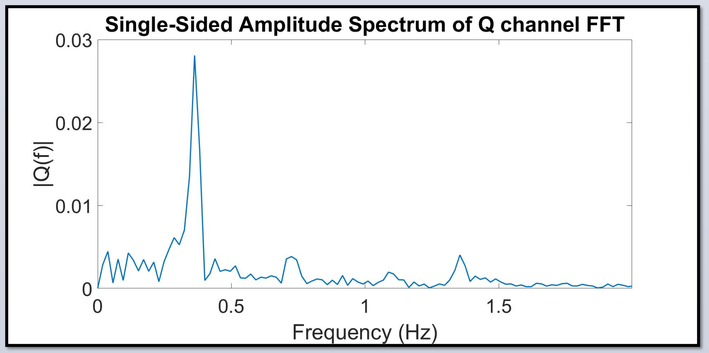


Experiment

- Serial Peripheral Interface (SPI) is used to communicate between the MCU and the external ADC, and Universal Asynchronous receiver/transmitter (UART) is used to transmit the digital signal to the computer.



- The two incoming signals are analyzed in the frequency domain for spikes representing respiration and heart rate
- Using a peak detection algorithm, the respiration and heart rates can be determined
- Precautions are taken to distinguish between the heart rate and the harmonics of the much stronger respiration signal
- Two filters are generated based on the expected respiration and heart rates to clearly visualize each component



User Interface

- The Graphical User Interface (GUI) system is built in Python to run as a Windows application without network connectivity
- The PC listens through UART communication to the experiment setup that is constantly transmitting data.
- Through the first screen, the user can specify how long to measure their vitals signal for
- Graphs of the user's raw signal, heart rate signal, heart rate transient, respiration rate signal, and respiration rate transient are displayed

Future Work

- Extract both channels containing the quadrature signals from the Data Output register of the external ADC
- Implement a commercial mobile application that accurately displays heartbeat and respiration in real-time
- Improve the existing UI by using a web application without network connectivity or more professional C# framework.

References

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Acknowledgements

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