

## ECE 4012 Project Summary

<b>Project Title</b>	Noncontact Vital Sign Monitoring System - YZ1	
<b>Team Members</b> (names and majors)	<div>Alec Adamski - EE</div> <div>Rohan Iyengar - EE</div> <div>Kedar Manishankar - EE</div> <div>Sai Sathiesh Rajan - EE</div>	
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<b>Semester</b>	Year/Semester	Circle: Either Intermediate (ECE4011) or Final (ECE4012)
<b>Project Abstract</b> (250-300 words)	<p>Noncontact vital sign monitoring is a promising method in the field of home health care, biomedical monitoring and the search and rescue applications. Data sampling and the processing of non-contact vital sign monitoring system should be nearly real time, to provide desired real-time information to our user interface. Practical implementation will first include the raw signal and sampling parameters, then perform processing. Our obtained signal contains the vital signs of our patient, such as heartbeat and respiration, among other important data, in analog form, and must be converted to digital form. Conversion to digital signal and sampling occurs on the microcontroller, which must also generate the trigger signal to the sampling chip. The digital signal is then communicated to a computer, where subsequent processing of the signal occurs in order to separate the signal into the transient and separate signals for the respiration signal and the heartbeat signal respectively.</p> <p>Real-time comparison and analysis of the obtained respiration and heartbeat signal of the patient with that of an expected respiration and heartbeat signal is critical to search and rescue operations. A key feature of our user interface is the option to display real-time respiration and heartbeat signals; mixed signal analysis must be performed to depict the respiration and heartbeat signals in the form of a wave. This will require research into effective toolkits to display graphs and which environment will be used, both on the desktop and mobile application. Cost effective measures include the use of a free Integrated Development Environment like Android studio to create a native mobile application, as well as the use of a microcontroller whose sampling chip is not high, due to bandwidth of the input signal being only several tens of hertz.</p>	

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List <b>codes and standards</b> that significantly affect your project. Briefly describe how they influenced your design.	<p>HIPPA is the law regarding privacy of medical data. As the sensor, workflow, and mobile app all handle sensitive data, this will require encryption and strong authentication to handle real data, as only medical professionals are usually allowed to handle the data this group processed.</p> <p>ANSI/AAMI ES60601-1:2005 standard by ANSI/AAMI applies to this product because it is a medical instrument. It will have to meet the safety and reliability standards set by this guideline. An example of required functionality is reducing the error rate and discarding certain results if the signal obtained is too noisy/inconclusive to not show possibly inaccurate data on a medical device.</p>
List at least two significant <b>realistic design constraints</b> that applied to your project. Briefly describe how they affected your design.	<p>The most difficult design constraint is the necessity to process and display the data in real time. Efficiency of the DSP algorithms must be taken into account in order to process the massive amount of data that could potentially be acquired.</p> <p>Another design constraint is making sure that the analog to digital converter can sample fast enough to capture all meaningful data. We will need to do significant research on what sampling frequency is necessary to accomplish our goals.</p>
Briefly explain two <b>significant trade-offs</b> considered in your design, including options considered and the solution chosen.	<p>One of the most significant trade-offs was the decision to do the actual signal processing algorithms on the computer as opposed to on a dedicated DSP chip. While doing the processing on the chip itself is likely to be more energy efficient due to its optimizations, the computer is likely to be sufficient for our purposes. In addition, it gives us more flexibility with regards to the programming language we use for the algorithms. Secondly, we had to choose between wireless and wired communication protocols to transmit information from the microcontroller to the computer. Wireless Communication would give the ability to operate the equipment in a unencumbered manner, but we decided that the added complexity of implementing it would make it undesirable at this stage since the patient has to be in close proximity to the antenna used to collect the data at this stage.</p>
<p>Briefly describe the <b>computing aspects</b> of your projects, specifically identifying <b>hardware-software</b> tradeoffs, interfaces, and/or interactions.</p> <p><i>Complete if applicable; required if team includes CmpE majors.</i></p>	<p>The most notable hardware-software interaction is the process of receiving an analog waveform signal and converting that into a digital data stream to be processed by the computer. The interactions between the two devices will be handled by a microcontroller. There are two possible scenarios with this design. (1) The amount of data the computer can process is bottlenecked by the A-to-D converter. (2) The computer is not able to effectively process and display the necessary data in real time. The former would be preferential. Hence, one major tradeoff will be the sampling frequency of the A-to-D converter vs the amount of data the computer can process and display in real time. The output of the computer will have to be greater than or equal to the rate of the input data stream of the A-to-D converter to accomplish this goal.</p>

## ECE 4012: International Program

(Only groups with one or more International Program participants need to complete this page)

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Global Issues (Less than one page)	<p>Our project will handle heartbeat and breathing rate data, among other types of data that can be inferred from processing of mixed signals. This data all falls into the classification of medical data. The European Union has privacy standards that apply to all member countries and therefore determine how a majority of Europe handles privacy standards. China has standards for health related information, but these policies are not enforced as stringently with the Chinese court system.</p> <p>In contrast to a unified policy, the United States has very strict policies protecting the privacy of medical records. Only people that the owner of the record gives permission to, medical professionals giving treatment, and the person to whom the records pertain to can view the records. Our project will be collecting signal data private to an individual, so making sure this product in production conforms to these international as well as domestic standards is important. Producing a working prototype is important but for this to see wide use encryption and other tools must be used so the medical data is secure depending on the scope of our international clientele.</p>