

PROBLEM STATEMENT

In this project, our group is tasked with developing a program system used for ultrasound brain imaging. The client has already obtained hardware for the project. We need to interface with the hardware and program it for the suited application, which is, to obtain images of the brain through the skull bone.

DELIVERABLES

FIRST SEMESTER

1. Diagram the ultrasound brain imaging system and interface with machine hardware.
 - Block out the basic idea of the beamformer and receiver.
 - Learn how plane waves and traditional ultrasound image with multiple focal zones and arbitrary will contribute to the development of the product.
2. Become proficient in labVIEW and implement knowledge from other programming languages we have experience with.
3. Programing the beamformer to transmit plane waves.
4. Program the beamformer to generate a traditional ultrasound image with multiple focal zones.
5. Program the beamformer to select arbitrary phases for each array element.

SECOND SEMESTER

1. Assess adjustments that need to be made to the previous semester's design.
2. Program the receiver to collect echo signals and form the ultrasound image offline.
3. Program the receiver to collect echo signals and form the ultrasound image in real time.
4. Develop documentation and a user guide for operating.

SPECIFICATIONS

The designed system will be used to create images the user's brain. The images will be produced in our labVIEW program in aid of the NI (National Instrument) hardware that is provided. The system will be expected to meet the following criteria.

Sample preparation

- The beam former ultrasound hardware must be able to transmit plane waves, generate a traditional ultrasound image and select arbitrary phases for each array element.
- The receiver ultrasound hardware must be able to collect echo signals form the ultrasound image offline and in real time.

Evaluation of Ultrasound Hardware and LabVIEW Software Setup.

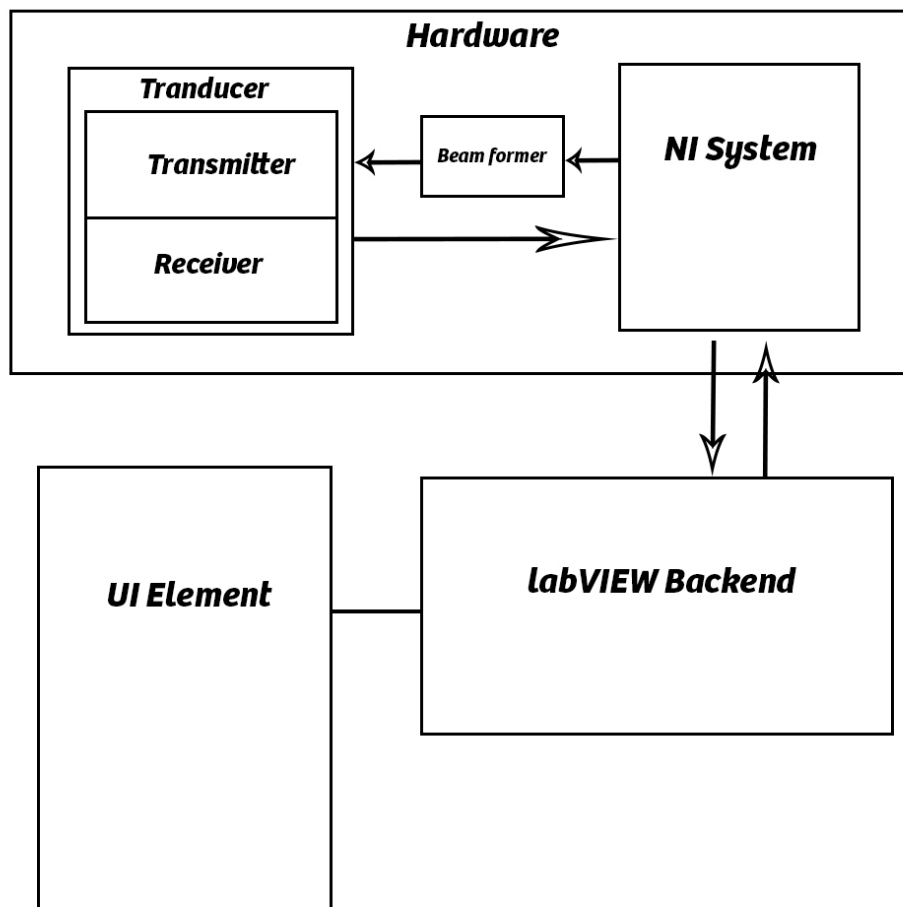
- Must read all the document which is include in the manual of the ultrasound hardware.
- Must understand the structure of how ultrasound hardware produces signals.
- Must be able to evaluate correctness of all functions and channels of the ultrasound hardware and that they work properly.

- Must back up the origin software and files in the ultrasound hardware.
- Must make sure the LabVIEW software can interface with ultrasound hardware properly.
- Must produce expected output imagery and run in realtime.
- Create a repository for code and write documentation so that the project can be developed on later.

EXPERIMENT DESIGN

The labVIEW instrument should produce imagery of the brain provided the receiver and transmitter produce expected I/O. Users should also be able to interface easily with the product and tune it if necessary.

CONCEPT SKETCH/MOCKUP



SOFTWARE & CONTROLS

For the beam former, all programming process work will be prepared, designed, debugged and tested in LABVIEW. We will make sure that the beam former can transmit plane waves correctly. We will also make sure that the beam former can generate a traditional ultrasound image with multiple focal zones and can select arbitrary phases for each array element.

For the receiver, all programming process work will be prepared, designed, debugged and tested in LABVIEW as well. We will make sure that it can collect echo signals from the ultrasound image offline and in real time.

USER INTERFACE DESCRIPTION

SOFTWARE

The software will have a graphical user interface, which will show imagery as well as controls for tuning and running the system.

FUNCTIONAL REQUIREMENTS

In order to make the system functional we must

- Interface with the hardware.
- Configure it for transmitting and receiving waves in the correct context.
- Use signal processing to analyze the wave data.
- Develop a way to create images from the wave data

CONTROL & AUTOMATION

Data will be streamed in real time at target of 30fps. This will mean making an efficient program that quickly analyzes data and outputs results. If there is an error with the hardware or data, the system will notify the user.

NON-FUNCTIONAL REQUIREMENTS

Our product needs to display accurate results because it is intended to be used as a precise medical device. However, this project is a lab experiment, so it will not be brought to market. Therefore, the goal is get a prototype working, not develop a commercialize-able product. Therefore, non-functional requirements are relatively lenient.

WORK BREAKDOWN STRUCTURE

All members in our group are required to study LabVIEW individually. All members must carefully read through the user manual of the ultrasound hardware to understand the structure of the machine and know how to use the labVIEW interface functions. At the end of this first semester, our plan is that make sure the beam former and receiver of the certain channel work correctly. Our group has decided on the following roles:

Aaron Tainter: Programming Leader
Weikun Han: writing paper leader
Jingyu Xie: schedule timeline leader
Haoyu Wang: presentation leader

All members must follow instructions from the specific leader.

RESOURCE REQUIREMENTS

Resource	How will we get it?	Estimated cost
Custom ultrasound hardware	Provided by client	N/A
Computer with LabVIEW installed	Provided by client	N/A

PROJECT SCHEDULE

Number	Task Name(Beam former)	Date
1	Understanding the background of the ultrasound functional brain imaging system.	Sep-14
2	Familiarizing with the machine hardware structure.	Sep-14
3	Beacially study and practice labVIEW.	Sep-14
4	transmit plane waves	Oct-14
5	generate a traditional ultrasound image with multiple focal zones.	Nov-14
6	select arbitrary phases for each array element.	Dec-14
	Task Name(Receiver)	
4	collect the echo signals and form the ultrasound image off line.	Jan, Feb-15
5	collect the echo signals and form the ultrasound image in real time.	Mar, Apr-15

RISKS TO THE PROJECT TIMELINE

Currently, the hardware vendor is behind on schedule. Additionally, the funding for the hardware may be revoked if it cannot be delivered in time. This would mean that we could only code half of the project and be unable to test. This is huge problem that is currently being addressed by professor Bigelow

PHYSICAL DANGERS:

The main risk is that the hardware gets damaged. Obviously, lab equipment like this is very expensive, so we need to be careful.

MARKET/LITERATURE SURVEY

The goal of this project is to build a functional prototype from concept that works in lab. Currently, this is a research project that is not intended to be commercialized.