Drop-Tower Triggering System

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ABSTRACT

The purpose of this senior design project was to create an effective triggering system for both a VSX ultrasound scanner and a high speed camera. To do this, our team designed a system which implements a photoelectric sensor and a microcontroller to trigger the data collection with minimal human input. With this design, our team will be able to successfully decrease the amount of frames wasted from the high speed camera and VSX scanner, as well as synchronize the triggering of the two devices.

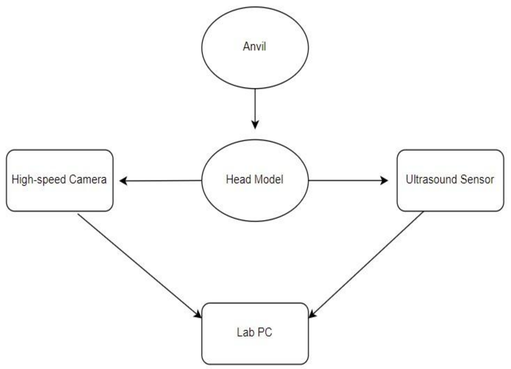

Figure 1

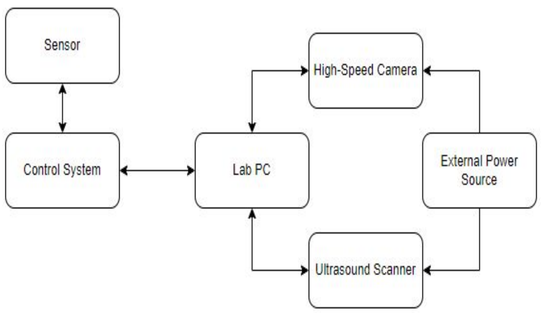

Figure 2

BACKGROUND

This system will be used by the Chemical Engineering department for their experiments on cavitation injuries to the head. The current system in use by the Chemical Engineering department consists of a weighted anvil being dropped on a human head model. [Figure 1] The VSX ultrasound scanner as well as the high speed camera are initialized and started at the same time the weight is dropped.

This results in the VSX ultrasound scanner and high speed camera triggering early, creating erroneous and empty frames before impact. The main purpose of these experiments are to capture the frames that show the exact moment of impact as well as the frames immediately after.

By implementing our design, we can eliminate some of these inefficiencies as well as reduce the time consuming workload for the Chemical Engineering team.

EXPERIMENTAL SECTION

Conceptual Design **[Figure 2]**

- Sensor detects when the anvil has fallen close to the head model
- The signal from the sensor is used to trigger both the high speed camera and the VSX ultrasound scanner
- The data is recorded from the high speed camera and VSX ultrasound scanner to the lab PC

Technical Design **[Figure 3]**

- Uses a photoelectric sensor which communicates through Serial Communication (Digital I/O port)
- Uses a Teensy 4.0 as a control system due to speed and efficiency
- MATLAB is used to trigger the VSX ultrasound scanner and high speed camera

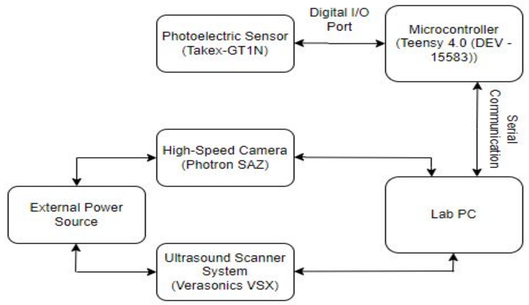

Figure 3

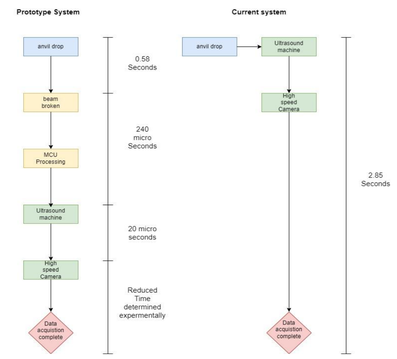

Figure 4

RESULTS

Through experimentation, we found our chosen sensor to be an NPN type, meaning that the output is low when the sensor is connected, high when it is broken. We also found that the Teensy was able to communicate with MATLAB via the serial port on the computer.

After integrating all components of our system together, we were able to successfully trigger the sensor and send data over the serial port to the PC. This allows the MATLAB script being used by the Chemical Engineering Department to read the data coming in from the serial port continuously and start both systems simultaneously.

DISCUSSION

With our design, we would be able to remove the amount of empty frames almost completely from the beginning of the experiment. Depending on drop height and anvil weight the total data acquisition time can be decreased by as much as 20%. This allows for the possibility of higher quality data as higher frame rates can be achieved. (Figure 4)

Future Work

The most obvious way to improve this system would be to generate a more permanent breadboard design such as a PCB. Due to unforeseen circumstances, the design was required to stay on a full sized proto board. It would also be ideal to further test the system with more live trials on the drop tower. Collecting this experimental data would allow the system to be more fine tuned and would allow for timings to be controlled more precisely. In the next two weeks, we will be fully integrating our system with the current system.

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