S.P.O.T.T.E.R

Honors Enrichment Award Report

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The Honors program generously donated $50 to help fund our Mechatronics Project this spring. The project requires students to build a mechatronic system consisting of a display, audio output, sensors, manual user input, actuators, and logic run through a series of electrical components.

How it Worked:

Our device, the SPOTTER, was a long range shooting target developed to assist marksmen in recognizing impact location and monitoring different holdover conditions. The procedure of use of the device begins with the opening of the Pelican Case and the flipping of the switch. Once the LCD lights up, the user has the choice of three screens they can then access, including the range input, shot detection, and sensor input pages.

Logically, the first step would be to determine the range to target. When this page is accessed, the user is then asked to input the minutes of angle (MOA) of the target as it appears in the scope. Using a curve fit, this manual input calculates a distance to target, and reports an appropriate minute of angle adjustment to hit the target vertically dead center.

As the screen transitioned to an impact location screen, the home station then signaled the target station to erect and anemometer, collect fifteen seconds of wind data, and report that information back to the home station. This information was then stored, and a MOA was calculated for the horizontal direction, which was then also shown on the impact location screen.

At this point the impact location screen would await a shot, as sensed by a microphone threshold level. If this value were surpassed, a timer began, awaiting data from the transmitters. If the transducers recognized a significant change in voltage, the system recognized the scenario as a hit, and transmitted that information back to the home station. Based on the information the home station received, the device would display on the LCD either a hit or a miss, as well as play a hit or miss wav file on a speaker.

The final screen was a sensor readout screen, which polled a sensor and wrote the wind speed in mph, altitude in ft, barometric pressure in inHg, and temperature in °F. These conditions could then be used for interpolations of MOA from tables already developed by marksmen, though these conditions, with the exception of wind, were considered constant for our device MOA readouts, meant for use on a mild summer day in Fort Collins.

Ultimately, we had hoped to achieve impact location triangulation, but significant difficulty occurred in the merging of the independent systems (home, transmission, and target) and thus sufficient time did not exist.

Takeaways:

During device development, we encountered many roadblocks. From the start, we overestimated our capabilities. We dreamed big, and despite working very hard, we were unable to meet these demands. However, though we initially wished we had picked an easier project, we learned way more from this project than we ever would have from some of the other, simpler projects that we had considered.

One significant takeaway from this class was the impact of the design paradox. The design paradox basically details that as time increases, your knowledge about the device increases just as rapidly as freedom decreases. We found that as we purchased components and began implementing them in our device, we should have done more preliminary research. It was not uncommon for us to realize that the components we had purchased were not what we needed only after they had already arrived. This will serve as a reminder to us as we continue through engineering school and eventually our jobs that thorough research ahead of time can save significant time and money in the long run.

Another takeaway was with regards to teamwork and role delegation. When we obtained our sensors and componentry, we divided up who would take responsibility for what portions of the project. Unfortunately, we found that the delegation was relatively unbalanced. In the future, we again need to conduct more preliminary research to properly designate evenly balanced roles for a system.

The other main takeaways are with regards to either hardware or software. With the hardware, we experienced issues regarding batteries and connections. We found that we used a surplus of batteries during the period where we thought testing was rapidly approaching, when the use of the variable power supplies would've been much more efficient up until the exact moment of testing. We also had a number of connectivity issues, which we resolved by using solder and heat shrink more effectively.

Regarding software, we had trouble implementing the three codes of the home station, transmission, and target station. As we continued developing, we found that it would've been simpler had we developed and tested code incrementally, rather than each finish our separate codes and then try to integrate them. We also found that revisions are key to making a device function properly. By saving revisions at major checkpoints of functional operation, edits don't compromise the work that has already been completed. Lastly, we found that though code writing for a broad usage of the code may be ideal, writing it for the specific application of it is more efficient both in terms of writing time as well as operation time.

Funding:

Because of our lack of experience and expertise, this project became costly very quickly. Though the majority of the cost was in a few components ($210 for the AR 500 steel plate and two transmitters), small unforeseen costs added up quickly. Thanks to the Honors College's help, we were able to complete a project that we were proud of, rather than sacrifice device complexity because of funds we lacked. Thanks again for your support!