Texas A&M University at Qatar
Electrical and Computer Engineering Program

ECEN 403-502

Electrical Design Laboratory I

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Benchmarking Report

Data Logger for Mechanical Systems

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"On our honor, as Aggies, we have neither given nor received unauthorized aid on this academic work."

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Introduction

The purpose of this report is to perform benchmarking on our senior design project by comparing it with existing products in the industry that have similar functionalities. By doing this, we are able to get a more in-depth look into the approach that other engineers took when with faced the problems given by their customer. Ultimately, we will be able to tell how our current design stands against the current products, and we will attempt to improve the possible inadequacies in our design.

We have found three products that have similar functionalities to our design. The first one is the H.E.A.T. Evaluation Module from Texas Instruments[1]. Like our project, it is a PCB that logs the performance of mechanical tools using various sensors. The second product is CompactDAQ from National Instruments[2], which is a stand-alone platform instead of is a bare PCB but still a rugged data logger. The third product is MSR145 from CiK Solutions[3]. It is also a stand-alone platform that records data against time. Pictures of all the products are shown in Figure 1.

Figure 1a: The Harsh Environment Acquisition Terminal Evaluation Module

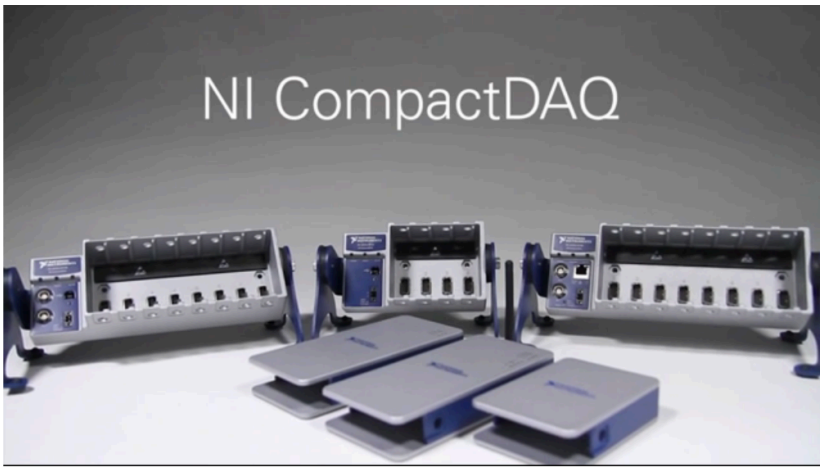

Figure 1b: CompactDAQ chassis with its various modules

Figure 1c: MSR145 inside its design housing

Benchmarking Criteria

We have decided on the following metrics that are most relevant to our design. For our design, some of the details are still undecided. But, we will still compare these details to help us decide later on.

1. **Operation time**: this assesses how efficient the product is in terms of power consumption. This is important because operations may take around 24 hours to complete while the product is inaccessible during that time.

2. **Power source:** this shows from where the product draws power. Could be onboard battery, connected to an external power supply, etc.

3. **Dimensions:** this assesses the size of the product. The smaller, the better since it might not fit in smaller mechanical tools.

4. **Sensors:** this shows what kind of sensors the product has. The more, the better assuming it does not affect the dimensions.

5. **Memory:** this assesses how much data the product can record without overwriting older data. The larger, the better assuming it does not affect the dimensions.

6. **Acquisition frequency:** this shows how often the product logs the data against time. The higher, the better assuming the memory can handle it.

7. **Temperature tolerance:** this assesses how the product handles harsh environment conditions, which in this case is temperature associated with downhole operations.

8. **Connectivity:** this shows what and how many types of connectors/buses are available in the product. The more, the better assuming it does not affect the dimensions.

9. **Price:** this assesses the reasoning behind the price tag of the product.

Benchmarking Table

The comparison between our design and the similar products based on the metrics we decided on are shown in Table 1.

Table 1: Benchmarking Table

Metric	Our Design Project	H.E.A.T Evaluation Module	CompactDAQ (cDAQ-9134)	MSR145 (Standard IP 60)
Operation Time	Undecided *	Infinite	Infinite	2-3 Months
Power Source	Battery*	3.3 V External Supply	24 V 5A External Supply	Lithium-polymer battery (800mAh)
Dimensions (LxWxH)	5x1x1 inches*	8x1x0.93 inches	8.66x4.6x3.4 inches	2.8x1.5x0.9 inches
Sensors	Rotation, translation, vibration	Rotation, pressure, temperature	Holds 4 External Sensors from 50+ sensor modules	Holds 5 External Sensors from 8 different sensor modules or any analog signal
Memory	Undecided *	Onboard 32 Mbit	SD Card (Max 16 GB)	Onboard 8 Mbit
Acquisition Frequency	1 per second	Up to 128k per second	Up to 50k per second	Up to 50 per second
Temperature Tolerance	175 ˚C	210 ˚C	70 ˚C	65 ˚C
Connectivity	CAN	CAN	CAN/USB	USB
Price	N/A	$ 5749	$ 7068	$323 (Excluding Sensors)

* Most of our design is still in its early stages and these data are approximated

Study Analysis and Summary

After doing this study, we found several things that we could do to improve our design. They are summarized in the following points according to the metrics highlighted in bold.

1. **Acquisition frequency:** this was the most important metric where our design falls short. Currently we designed a 24-hour clock that has increments of seconds using C code. From our conclusion in our ethnographic study, we may implement a burst-logging mode that triggers when the sensors detect certain types of motions. We will have to make the frequency much higher so that it stacks up against the other products.

2. **Sensors:** right now, we focused from our customer needs assignment on the things that companies want from these data loggers. However, we may decide to implement a modular design like some of the similar products. This, of course, must not interfere with our **size** constraint since it is also requested by our customer.

3. **Power source:** we still have not decided on the type or the capacity of the battery that will power our design. The MSR145 from CiK Solutions seems to be very good in terms of **operation time**, so we might consider doing something similar to them.

4. **Memory:** this is still a vague part of our design right now. As of right now, we are thinking of storing our data logs in an onboard memory and then transferring it using CAN to a computer software. But, SD cards could be a better option since it is a prevalent standard that is available in a lot of devices right now. This must not interfere with the **temperature tolerance**, though. So if we decided to use SD cards, we will have to find a way to make it work in harsh environments.

References

[1] Retrieved from http://www.ti.com/tool/heatevm

[2] Retrieved from http://www.ni.com/data_logger/modular.htm

[3] Retrieved from http://www.cik-solutions.com/en/catalog/monitoring-datalogger/msr/products/