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**A “Wave” of Vital Information:** How an NCSSM Researchers AI wearable enables continuous biometric data monitoring

You just finished your morning run. *160 BPM heart rate, not bad at all.* Glancing at your FitBit enables you to quickly track your vital data, and note how effective the workout was. That’s real data – information that enables you to better understand your own body and health, serving you in improving your well-being. That said, imagine how important this data is for scientific researchers. Worldwide, active research across health domains faces a significant bottle-neck: there’s limited access to open-source, accessible biometric data or information. Traditionally, collecting this data requires sophisticated (often IRB-approved) user studies, and even then, labs often keep such data private. What if there was a device + online platform that could enable biometric data to be easily collected, documented, and uploaded for use by scientific research communities? That’s the idea NCSSM student researcher, Hadi Abdul, sought to chase after with Duke University’s Big Ideas Lab under Professor Jessilyn Dunn.

At the start of his senior year, Hadi began his research term with NCSSM’s mentorship program unsure of what to expect. He knew he was generally interested in bio-medical technology but didn’t understand what exactly biomedical engineering research looked like. It wasn’t until joining Dr. Jessilyn Dunn that he’d be exposed to a pertinent issue influencing modern BME research, especially given the modern relevance of data-intensive statistical models (e.g. AI) within the field.

“Data is challenging to access,” Hadi told me. “Especially in developing countries. For example, I learned about researchers in Uganda whose efforts were being halted by the low access to biometric marker data sourced within the region.” That inspired him to pursue an

interesting challenge - what if Hadi could make his own wearable device (a watch, similar to a FitBit or Apple Watch) that could source biometric data (e.g. heart rate, temperature, orientation) for both user study use *and* public use, to build biometric datasets. Through NCSSM's mentorship program, he had the opportunity to be one of the only high school students in the Big Ideas lab pursuing the exciting project as a culminating endeavor of his senior year.

It wasn't easy by any means at the start for Hadi. Having had limited experience on the engineering side, he first had to understand how non-invasive health sensors function and can be integrated into a device.

“A huge win for us is that we were able to source a chip with access to all 6 integrated sensors I wanted, simplifying the project design”, Hadi told me. His device was effectively designed to collect signals PPG, ACC, GYR, MAG, HUM, and TMP, at a 100 Hz sampling rate. The signals represent the collection of heart rate, motion activity, rotational movement, orientation sensing, humidity, and skin temperature respectively. Throughout the first semester, Hadi learned the device design process to manufacture his first example watch.

Simultaneously, he also gained deep exposure to the research ecosystem at Duke, a skill which he noted will be super valuable for the rest of his life. Hadi was able to meet an assortment of researchers in his lab focused on a diverse set of problems within his general field of interest. He'd often gain help from other student researchers (PhD students) while working on his own device. An exciting side project he also participated in was writing an article for *Duke Vertices*, where he wrote about the Big Ideas Lab and their work in medical device research. That experience taught him that scientific research isn't just about the technical side, but also how to communicate scientific ideas.

In the second semester, Hadi got to see his work result in tangible impact and results. With a partner in the lab, he was able to test his biomedical device and track real biometric data effectively. He tracked heart rate versus physical activity, leveraging the PPG and ACC sensors he integrated into the watch. The accuracy of his tests validated that his watch could serve as a real research-grade device. Now, Hadi is continuing work attempting to program a digital platform for the Big Ideas Lab to upload their biometric data for public access. He hopes the platform will serve as a powerful resource for groups, such as the researchers in Uganda he learned of, who could use the data to conduct their own research on health conditions.

It's hard to distill Hadi's journey into a single lesson. His work demonstrates that research can be an unexpected experience that stretches and challenges high school students in more ways than one. Yet, beyond that, his work also directly reflects the importance of designing systems that make data safe to procure, and publicly available, to advance spaces as sensitive as medical research. Moving forward, Hadi hopes to study biomedical engineering, or a related field, in college, where he is excited to continue pursuing research.