MicroData: Mobile and distributed sensing with the micro:bit

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ABSTRACT

The micro:bit is a physical computing device with a variety of sensors that makes it an effective tool for mobile data collection. Additionally, the micro:bit's radio enables sensed data to be transmitted wirelessly. Data collected in this way bit can either be logged into the micro:bit's non-volatile memory or can be transmitted to a PC or tablet for live visualisation. In this work we explore a new approach: live data visualisation directly on the micro:bit via a display shield accessory. By leveraging the micro:bit, its radio, and a display shield, we support a range of mobile and distributed sensing experiences that empower learners across a variety of activities.

1 INTRODUCTION

Mobile sensing has become ubiquitous, from a range of environmental monitoring scenarios to health and exercise tracking with body-worn devices. This trend makes sensing a natural topic for teachers to cover with their students. Unfortunately, it can be hard to experiment directly with sensors and the raw data they generate.

Physical computing is a creative framework for building interactive systems [4] that naturally lends itself to experimentation with sensors and sensor data. The *BBC micro:bit* [1] is a proven physical computing technology [3] that packs a variety of sensors and radio communications into a small form-factor that is easy to program. Furthermore, rich interactive applications can be built using a number of commercially-available *display shield* accessories, one of which is shown in Figure 1.

2 INTERACTIVE MOBILE SENSING

MicroData [5] is an application we have created that runs on a micro:bit. When coupled with a display shield, it supports interactive data recording and visualization. It also supports micro:bits that are used without a display shield; in this case sensed data is recorded and may also be transmitted wirelessly for display on another micro:bit. MicroData provides an easy-to-use interface that allows the user to record and visualize up to three sensors at once in real-time.

Support for radio communication and flashing data to storage is provided by micro:bit libraries imported by MicroData. These libraries provided a high level interface in Static Typescript [2], linked with C++ at compile time. This enables fast, iterative development, without foregoing the performance for C++, which is important for embedded applications.

MicroData makes it easy to coordinate sensors between micro:bits. A micro:bit with a display shield can setup logging of temperature data on other micro:bits at fixed intervals, or send a radio notification when acceleration crosses a set threshold, and stream luminosity data back in real-time simultaneously. This system is highly portable, making it suitable for use around the classroom, the school or even outdoors. This distributed logging is shown in **figure 1**.

In the context of a school setting there are two immediate user stories to demonstrate its use cases:

- a student can carry out an experiment over a wider area - such as investigating differences in temperature across a room over the span of a day;

Figure 1: Two battery powered micro:bits log accelerometer data and send it over radio to a micro:bit with a display shield, which saves it to flash storage and displays it in a tabular format.

- a teacher can more easily coordinate experiments with a classroom of micro:bits from a single device.

These user stories demonstrate how distributed sensing could expand the pedagogical capabilities of the micro:bit by enabling students to experiment directly with sensors and better understand the data they generate. They can also explore using the sensors as part of practical experiments in other subjects such as physics. In the future we plan to test these ideas in real-world settings including an in-classroom study where students engage in practical mobile and distributed sensing experiments using MicroData running on multiple micro:bits.

REFERENCES

[1] Jonny et al. Austin. 2020. The BBC micro:bit—from the UK to the world. *Commun. ACM* 63, 3 (2020), 62–69. https://doi.org/10.1145/3368856
[2] Thomas Ball et al. 2019. Static TypeScript: an implementation of a static compiler for the TypeScript language. In *Proceedings of the 16th ACM SIGPLAN International Conference on Managed Programming Languages and Runtimes, MPLR 2019*. ACM, 105–116. https://doi.org/10.1145/3357390.3361032
[3] Kobi et al. Hartley. 2024. Meet MicroCode: a Live and Portable Programming Tool for the BBC micro:bit. In *23rd annual ACM Interaction Design and Children (IDC) Conference*. ACM.
[4] Steve Hodges, Sue Sentance, Joe Finney, and Thomas Ball. 2020. Physical Computing: A Key Element of Modern Computer Science Education. *IEEE Computer* 53, 4 (2020), 20–30. https://doi.org/10.1109/MC.2019.2935058
[5] Kier et al. Palin. 2024. MicroData: live visualisation & recording of micro:bit sensor data. In *Proceedings of the 19th WiPSCE Conference on Primary and Secondary Computing Education Research (WiPSCE '24)*. ACM. https://doi.org/10.1145/3677619.3678135