FabricBus: Shared Power and Data for Reconfigurable Wearable Modules

Akihito Noda
Kochi University of Technology
Japan
noda.akihito@kochi-tech.ac.jp

Abstract

Wearable systems with distributed sensors and actuators often require dedicated wiring or self-contained modules with individual batteries and wireless transceivers, making garments difficult to prototype and reconfigure. We demonstrate FabricBus, which uses a double-sided conductive textile as a shared bus for dc power and addressed serial communication. Detachable circuit modules can be placed at different positions without point-to-point wiring and receive power from a common system-level source through the same textile layers used for data transfer. A small interface circuit enables carrierless communication at up to 1 Mb/s. The demonstration presents several wearable configurations using LED modules to visualize independent control, flexible operation, and manual rearrangement of module layouts. The same platform can support distributed sensors and actuators for wearable sensing, display, and haptic applications.

CCS Concepts

• **Human-centered computing → Interaction devices**.

Keywords

Conductive textiles; e-textiles; smart clothing

ACM Reference Format:
Akihito Noda. 2026. FabricBus: Shared Power and Data for Reconfigurable Wearable Modules. In *Companion of the 2026 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp Companion '26), October 11–15, 2026, Shanghai, China.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3798063.3839223

1 Introduction

Wearable computing is increasingly extending from single, self-contained devices to systems in which sensors and actuators are distributed over the body surface. Such configurations support posture and motion capture, distributed physiological sensing, on-body displays, and haptic feedback [2, 4]. However, prototyping these systems remains difficult because module placement, density, and function may need to be revised repeatedly, whereas conductive paths in many e-textile implementations are fixed during fabrication. Prior work has therefore explored fabrication methods and modular platforms that simplify the construction and reconfiguration of interactive textiles [1, 2].

Surface-based and modular interconnection schemes provide another approach to reducing fixed point-to-point wiring. Pin&Play connected objects to a shared surface through physical pins [5], while more recent wearable platforms have used removable modules and textile substrates to support reconfigurable sensing and haptic layouts [2, 4]. These studies demonstrate the value of separating module placement from the final garment layout. At the same time, distributing both power and data to many small modules while maintaining garment flexibility remains an important implementation challenge.

We present FabricBus, a shared power-and-data infrastructure based on a double-sided conductive textile. The two conductive layers, separated by an insulating layer, form a continuous bus across the garment. A common system-level source supplies dc power, and a controller transmits addressed UART (universal asynchronous receiver/transmitter) data over the same two layers. The distributed modules therefore require neither dedicated point-to-point traces nor batteries or wireless transceivers of their own. Modules can be removed and repositioned while the system is powered off, allowing their number and layout to be changed without redesigning the conductive pattern.

Our earlier work demonstrated simultaneous power and data transfer over double-sided conductive textiles using I^2C and simplex communication schemes [3]. FabricBus uses carrierless asynchronous serial communication through a UART interface available on most off-the-shelf microcontrollers (MCUs). It achieves data rates of up to 1 Mb/s using a small interface circuit in each module.

This design has two important implications for distributed wearable systems. First, the entire textile surface provides access to the same power and data bus, allowing module layouts to be manually reconfigured without redesigning individual interconnects. Second, the same textile infrastructure can accommodate modules with different functions. The demonstration presents several wearable configurations that illustrate shared power and data delivery, detachable module placement, and manual reconfiguration of module layouts. LED-based examples are used to make the operation visible, while the same platform is intended for distributed sensing, actuation, display, and haptic applications.

2 Demonstration

The FabricBus demonstration presents several wearable configurations constructed from double-sided conductive textile and detachable badge-type circuit modules. As shown in Fig. 1, the textile consists of two conductive layers separated by an insulating layer. The two conductive layers form a shared bus that distributes dc power from a common system-level source together with addressed

ACM ISBN 979-8-4007-2533-3/2026/10
https://doi.org/10.1145/3798063.3839223

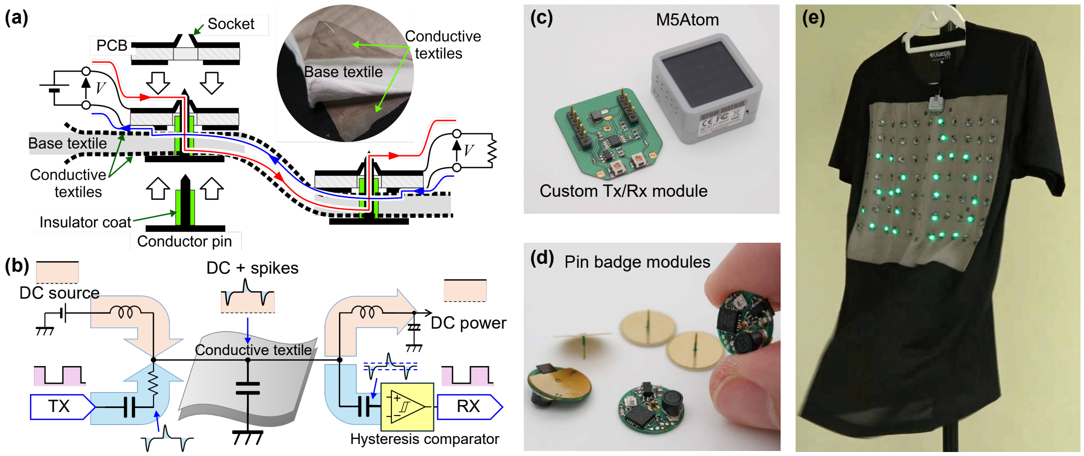

Figure 1: FabricBus demonstration system. (a) Layered textile structure and cross section of the pin-badge connection. Two conductive textile sheets are placed on opposite sides of an insulating base textile and contacted separately by the connector pins. (b) Shared dc power and UART signal transmission over the conductive textile. The transmitted pulse edges are superimposed on the dc voltage, and a hysteresis comparator reconstructs the received UART waveform. (c) Custom transmitter/receiver interface module and M5Atom controller (M5Stack Technology). (d) Detachable pin-badge modules incorporating an MCU and an RGB LED. (e) Example wearable configuration with multiple modules distributed over a T-shirt and controlled through the shared textile bus. The garment remains sufficiently flexible to flutter in airflow.

UART data. The distributed modules therefore do not require individual batteries or wireless transceivers.

Each module is attached using a pin-badge-style connector that contacts the two conductive layers from opposite sides of the textile. Because the textile does not contain dedicated point-to-point traces, modules placed at different positions can access the same power and data channels. The number and arrangement of modules can therefore be changed without redesigning the conductive pattern. The present prototype is not hot-swappable; the system is powered off before a module is attached, removed, or relocated because the connector may temporarily short the two conductive layers.

Several LED-based configurations are used to make the operation of FabricBus immediately visible. These include an arrangement of individually addressable RGB LED modules, while other layouts demonstrate that the system is not limited to a fixed matrix configuration. After the modules are repositioned, the controller uses their assigned addresses to control them independently. During operation, the garment can also be bent, folded, and gently stretched while the modules continue to receive power and data through the textile.

FabricBus transfers dc power and asynchronous serial data through the same pair of conductive layers. Inductors separate the dc power path from the data path, while coupling capacitors inject and receive the UART waveform. Because the textile has substantial capacitance, a series damping resistor is used to suppress ringing, and a hysteresis comparator at each receiver reconstructs the digital signal. The prototype supports data rates of up to 1 Mb/s using a small interface circuit in each module.

Although LEDs are used for visual presentation, the same shared textile infrastructure can support modules for sensing, actuation, display, and haptic feedback.

3 Conclusion

This paper presented FabricBus, a conductive-textile platform that provides shared dc power and addressed UART communication to detachable wearable modules. The demonstration showed that multiple modules can operate through the same textile bus without dedicated point-to-point wiring or module-level batteries, while preserving the flexibility of the garment. Although RGB LED modules were used for visibility, the same approach can support distributed sensors and actuators in reconfigurable wearable systems.

Acknowledgments

This research was supported in part by JSPS KAKENHI JP25K03109 and JST CRONOS, Japan, Grant Number JPMJCS25N4.

References

[1] Konstantin Klamka, Raimund Dachselt, and Jürgen Steimle. 2020. Rapid Iron-On User Interfaces: Hands-on Fabrication of Interactive Textile Prototypes. In *Proc. CHI '20*. 1–14. https://doi.org/10.1145/3313831.3376220

[2] Yifan Li, Ryo Takahashi, Wakako Yukita, Kanata Matsutani, Cedric Caremel, Yuhiro Iwamoto, Sunghoon Lee, Tomoyuki Yokota, Takao Someya, and Yoshihiro Kawahara. 2025. Plug-n-Play E-Knit: Prototyping Large-Area E-Textiles Using Machine-Knitted Magnetically-Repositionable Sensor Networks. In *Proc. TEI '25*. Article 56. https://doi.org/10.1145/3689050.3705973

[3] Akihito Noda and Hiroyuki Shinoda. 2019. Inter-IC for Wearables (I^2We): Power and Data Transfer Over Double-Sided Conductive Textile. *IEEE Trans. Biomed. Circuits Syst.* 13, 1 (2019), 80–90. https://doi.org/10.1109/TBCAS.2018.2881219

[4] Ali Shtarbanov, Mengjia Zhu, Nicholas Colonnese, and Amirhossein Hajiagha Memar. 2023. SleeveIO: Modular and Reconfigurable Platform for Multimodal Wearable Haptic Feedback Interactions. In *Proc. UIST '23*. Article 70. https://doi.org/10.1145/3586183.3606739

[5] Kristof Van Laerhoven, Albrecht Schmidt, and Hans-Werner Gellersen. 2002. Pin&Play: Networking Objects through Pins. In *Proc. UbiComp '02*. 219–228. https://doi.org/10.1007/3-540-45809-3_17