# The Wearable Audio/Visual Unit:
## A Platform for Embodied Computer Performance

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**Abstract**

The paper proposes the *Wearable Audio/Visual Unit* project which aims to provide a uniform embedded wearable computer platform for live audio/visual performance. Targeted at the "do-it-yourself" performer with limited technical expertise and resources, this device will be designed using commercially available hardware, utilize open source software, and be made available as plans, software downloads, and collaboration through an online community. It is hoped that such an alternative to both the laptop computer and stacks of audio gear will change the nature of future live performance.

**Keywords**: wearable computing, mobile music, performance art

# Contents

# 1 Statement of Problem

The two main problems the WAVU (Wearable Audio/Visual Unit) project addresses are the replacement of single-purpose audio/visual gear and the need for a performative computer form factor.

## 1.1 Too Much Gear

Performing live music and visuals using commercially available gear generally requires a large amount of single-purpose equipment. These devices are rugged and built to last, but their generally large sizes makes them less feasible as traveling expenses increase and air luggage sizes decrease. The common solution to this problem is the computer which, being a general purpose device, can replace a stack of audio gear of differing functions. Most computers, however, are not road-worthy or designed for native stage-quality audio and, as detailed in subsection 1.2, suffer form inherent interface problems for the performer. [1]

## 1.2 The Computer is Not the Audience

> *live electronics and computer music are widespread in use, yet most performers still prefer mouse and knob boxes*
> - Sergi Jordá, *Digital Instruments and Players: Part I Efficiency and Apprenticeship* [4]

In most cases, contemporary computer performers perform live using "laptop" or "desktop" form factor computers which limits their physical interaction and performativity. General software design largely assumes the "mouse and keyboard" paradigm and the vast majority of computers available today are either desktops or laptops. It is no wonder that, as a result, the vast majority of computer performers "prefer mouse and knob boxes" for they see little alternative on the market. The WAVU project aims to provide such a system, albeit initially in instructional design form.

Fig. 1: The author demonstrating the embodiment of a wearable performance using the *robotcowboy unit* 2.1

> *The problem, then, for any live electronic music that would realise the instrumental paradigm, is to address not only the gestural, morphological and spatial disjunction in purely aural terms, but somehow to create the unified expressive persona normally associated with a solo performance, which is so easily destroyed by the rigidity and disembodiment of the electroacoustic sound.*
> - John Croft, *Thesis on liveness* [3]

For some, this forced instrumentation and performativity becomes the "message" itself. Listeners are asked to focus on the "aural performativity" as opposed to visual and physical actions in order to fully appreciate the art of the laptop musician [5]. For musicians seeking to embody their live sound, a wearable computer shifts the focus of the interaction from a physically separate machine back to the person (Fig. 1). By modularizing such a system, performers are more likely to think beyond the current paradigms and create their own interfaces, mappings, and performances. [6]

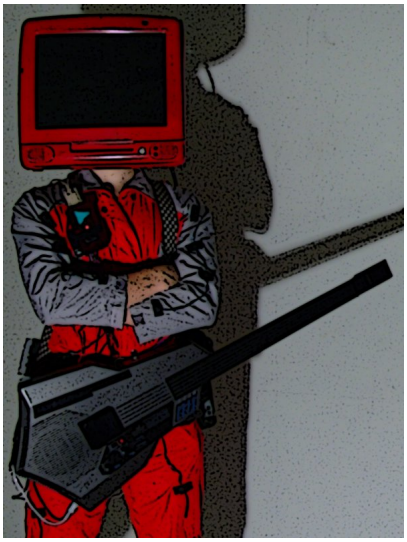

Fig. 2: *robotcowboy*: A self-contained cyborg performer using a wearable computer for live sound

# 2 Purpose and Significance

The purpose of the WAVU project is to foster and promote the low cost "everyman's" wearable performance computer. The rise of the laptop as the preferred mode of digital performance is largely due to cost and availability. It is the contention of the author that if an alternate form factor is proven and made available, there would be a great interest from current computer performers. By developing such a system using off the shelf hardware and open source software, the device would be affordable to working performers.

## 2.1 Previous Examples

Working proof of concepts exist in the author's masters thesis, *robotcowboy: A One-Man Band Musical Cyborg* [6], and the *AudioPint* project. The *robotcowboy* thesis project endeavoured to combine wearable computation and live physicality in order to present an engaging performance as expected by the more traditional guitar, bass, and drums combination (Fig. 2). The project

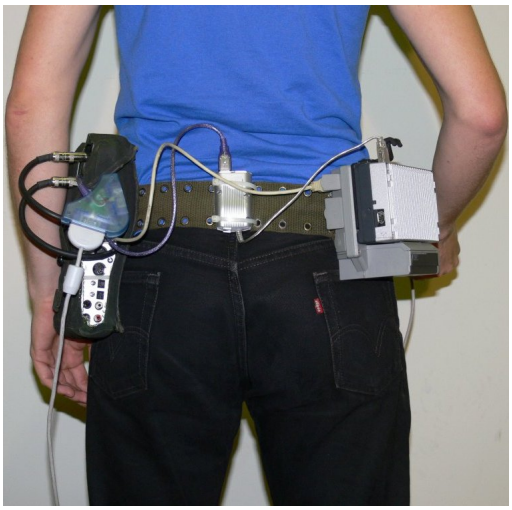

Fig. 3: The *robotcowboy unit*: A prototype wearable performance system on the body

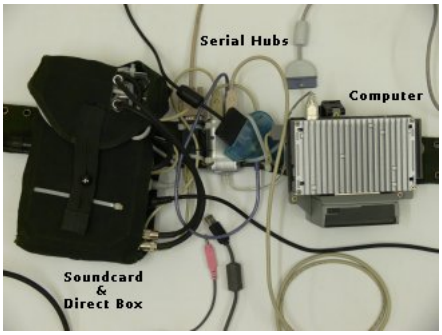


Fig. 4: The *robotcowboy unit*: A prototype wearable performance system, component detail

Fig. 5: The AudioPint road case

resulted in a working prototype system that has been showcased in several festivals and will undergo an extensive "stress test" as *robotcowboy* goes on tour from mid January to mid March 2007. After performing, the author has been questioned numerous times as to "where can I buy one of these"? Unfortunately, the *robotcowboy unit* wearable computer itself (a Xybernaut MA V) is no longer produced and neither is the commercial/industrial wearable computer in general.

The *Audiopint* project by Merrill, Vigoda, Bouchard, et al. in the MIT based InventMusic group aims for the "reinvention of the musician's audio toolbox". An Audiopint is a small, lightweight computer system housed in a road-worth traveling case (Fig. 5) so as to replace fragile laptops and mountains of single purpose audio gear. Several custom AudioPints (Fig. 6) have been built and see active service with one being used for David Merrill's PureJoy system [2]. The project took part in the May 2007 MAKE: magazine [1] Maker Faire and has a community wiki at http://www.audiopint.org. The WAVU and AudioPint projects share similar goals, hardware, and software and there will be close collaboration with WAVU focusing on the wearable aspects of the performance computer concept.

[1] http://www.makezine.com/


Fig. 6: David Bouchard's custom AudioPint with LCD

## 2.2 Significance

If devices such as the AudioPint, the *robotcowboy unit*, the WAVU were to come into widespread use, the nature of computer performance will change as users build there own interfaces and share ideas. A new and exciting dialog may begin as more and more people adapt the system and collaborate in building new instrumentation. Such an accessible, affordable system would promote its own use and bring many aspects of contemporary high "experimental" music, theatre, and visual performance down to the masses. The reception of live electronic and computer music would change drastically as the performances would reach the same excitement levels as those with more traditional instrumentation. One can only be excited to see the outcome.

# 3 Objectives

The main objectives of the project are as follows:

- Design and Prototype the System:
  Design a, small lightweight computer system with enough capability

for real time audio and video use using off the shelf components and minimal soldering/electronics assembly.

- Establish an Online Community:
  Publish all information (designs, instructions, schematics, parts list, etc) regarding the prototype as well as relevant performance experience using such a system on a community webpage such as a wiki.

- Promote the Concept:
  Take working examples out into the streets, clubs, festivals, and conferences for performance to both prove the concept and encourage people to build their own.

# 4 Procedures

The objectives as listed in section 3 will be accomplished as follows:

## 4.1 Design and Prototype the System

The design stage is largely built on the exerience of both the *robotcowboy* and *AudioPint* projects. The basic design requirements are low-cost and ease of assembly.

Design choices thus far:

- Main Hardware
  The small, low cost embedded motherboards from Via [2] such as the Mico and Pico ITX provide a fully capable Intel x86 platform for use with Windows XP or GNU/Linux operating systems. Via will be solicited for support fo the project through donations and technical help.

[2] http://www.via.com.tw/

A compact flash card, flash hard drive, or USB flash drive is required as a disk drive will be prone to failure do to excessive movement over time.

- Main Software
  The GNU/Linux operating system, available in numerous distributions, is a free, open source system that is fully configurable and can be booted from a flash card. There are numerous audio and visual applications for real time performance and it is an ideal environment for custom programming. Custom software needed for the project will be open sourced and available for downloading and packaging.

- Audio Engine
  Initially the real time audio patching language, Pure Data, will be used as it is extensible for a wide variety of uses. Arguably this is a more obtuse option for novice programmers. Through community patches, patch libraries, and tutorials there will be enough information for new comers to start on their feet. Other audio engines such as Super Collider and ChucK can be integrated into the system as needed. For more detail on the software implementation, please refer to [6].

- Peripherals
  Peripherals will consist of anything and everything USB (Universal Serial Bus: HIDs (Human Interface Devices) such as gamepads and wiimotes, bluetooth and wireless network adaptors, MIDI devices, custom microcontrollers such as the Arduino platform, tv tuners, fm radio tuners, etc. This means the interface and resulting performance options are essentially endless.

Once the prototype is assembled and ready for use, it will be extensively documented through instructions, diagrams, pictures, and video. It will be stressed tested and used in the field in order to ensure a quality design.

## 4.2 Establish an Online Community

A community website such as a wiki will be established and filled with the prototype information. A development blog can be useful to document prob-

lems encountered in the development and their solutions. New members will be encouraged to join and, in time, a mailing list and/or forum may be needed. The overall design should be similar to other open source artistic platforms such as the Arduino[3] and Processing[4] environments. Custom software used by the project will be available for development and download. Hopefully, there will exist cross collaboration with the operating system and audio engine open source communities.

## 4.3 Promote the Concept

Once both a working prototype and website are ready, the system should be taken on a tour of festivals, conferences, and music venues in order to spread the word through direct experience. As the saying goes "seeing is believing" and live demonstrations should encourage interest in the project and the concept. Workshops and exhibits at events such as the Maker Faire[5] offer a solid method in spreading the user base. Promotion is vital as the project is envisioned as having lasting significance at least in the experimental music arena. It will not be just another "dead project".

## 4.4 Time Schedule

Due to previous experience and software development, the time frame for a working prototype should be 3 months. Documentation and webspace development would take 3 - 4 weeks. Promotional time is approximate at around 6 months as festival and conference dates vary. The entire establishment of an ongoing project should then take about 10 months to a year.

[3]http://www.arduino.cc
[4]http://www.processing.org
[5]http://makerfaire.com/

### 4.5 Facilities Required

A workshop with tools and power equipment is needed for enclosure fabrication. Webspace for the project can be provided by the university or housed on the author's existing webspace.

### 4.6 Management and Evaluation

Once a more detailed timeline is established, it should be followed and progress should be evaluated at specific milestones such as receipt of initial parts, prototype first run, establishment of website, etc. A meeting with an advising faculty member once every 2 weeks would be sufficient for periodic overall project evaluation.

## 5 Personnel

The main personnel involved with be the author, Dan Wilcox, and a faculty adviser for evaluation and guidance. Further expertise such as from an electrical engineer or computer scientist may be required as technical problems are encountered.

## 6 Budget

The budget for the project consists of the equipment/material and webspace costs.

| Item | Price (in USD) |
|---|---|
| **Equipment/Material Cost** | |
| 1 Pico ITX motherboard | $300 |
| compact flash card | $50 |
| solid state harddrive | $150 |
| wireless USB network adaptor | $30 |
| bluetooth USB adaptor | $20 |
| several used gamepads | $20 |
| enclosure and building supplies | $50 |
| operating system and software | $0 |
| **Sub Total:** | $620 |
| **Webspace** | |
| webspace hosting for one year | $100 |
| **TOTAL:** | $720 |

# 7 Conclusion

As one can see, this is a viable project with a clear purpose: bring the flexibility of the computer to all aspects for live performance. The small size and weight of a WAVU can replace a large amount of single-purpose audio gear yielding more room for the traveller. It's wearable form factor encourages physicality in live computer performance and fosters creativity towards new interfaces and digital instrumentality. An available, low cost device would promote its own use among working musicians and its extensibility would ensure usage for quite some time. It is hope that the result of this project, if undertaken, is a widespread use of custom performance systems and engaging, rocking live computer shows.

# References


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