Autonomous New Media Artefacts (AutoNMA)

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ABSTRACT

The purpose of this brief paper is to revisit the question of longevity in present experimental practice and coin the term *autonomous new media artefacts* (AutoNMA), which are complete and independent of external computer systems, so they can be operable for a longer period of time and can be demonstrated at a moment's notice. We argue that platforms for prototyping should promote the creation of AutoNMA to make extant the devices which will be a part of the future history of new media.

Keywords

autonomous, standalone, Satellite CCRMA, Arduino

1. INTRODUCTION

For many decades, artists and engineers have been designing custom electronic interfaces for new media. Recently, this field has become especially popular as evidenced by the growth of the New Instruments for Musical Expression (NIME) conference, SIGGRAPH, other conferences, special sessions, and even attendance at massive do-it-yourself exhibitions such as the Maker Faire. Perhaps part of this trend is due to the wealth of documentation and tips now available on the Internet as well as the relative ease with which such interfaces can be prototyped. In this paper, we emphasize the value of creating prototypes that we call *autonomous new media artefacts*, or AutoNMA.[1] Because they are complete and independent of external computer systems, they can be demonstrated at a moment's notice, and they can be operable for a longer period of time.

Architects of some major edifices in the nineteenth century sometimes thought of the "future ruins" which they were creating. For example, an artist's rendition of the Bank of England was commissioned which depicted its future history [3]. Our interest is similarly related to processes of time, in this case the decay and erosion of our interfaces in new media. Most of the following discussion will pertain more specifically to sound, which is the specialty of our laboratory; however, we believe that the implications are the same for all new media (visual, haptic, etc.) that require significant computation.

[1]We would like to thank Wendy Ju for discussions on the subject as well as suggesting the term *autonomous*.

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2. MICROCONTROLLER WITH GENERAL PURPOSE COMPUTER

The most popular present platform for prototyping novel interfaces for sound creation consists of custom sensor circuits connected to a microcontroller, such as the Arduino, and a general purpose computer that receives sensor data over a data link and synthesizes sound [1]. Thus, the microcontroller's elegant interconnection with circuits is combined with the general purpose computer's ability to be programmed to perform many different kinds of sound synthesis. However, the general purpose computer does not operate autonomously. Consequently, over even only a few years, additional work is often required to keep prototypes running.

One the one hand, if a general purpose computer is *not* dedicated to the prototype, the prototype software may be affected by changes to other software on the computer, which may even be upgraded automatically or become infected with a computer virus, etc., potentially causing incompatibility with the prototype. Finally, the computer might become dedicated to a different prototype. No matter what, the general purpose computer will eventually require new hardware components or even become irreparable. Thus, eventually when demonstrating the prototype years down the road, additional effort will be required to preserve the data link between the microcontroller and the general purpose computer, especially as the data link technology may change.

The failure of custom new media devices is especially problematic for novel musical instruments, which may not survive long enough to allow a musician to develop virtuosic performance techniques, let alone repertoire. Some valiant designers continue to nurse their projects along over time to keep them alive despite changes to data link protocols and sound synthesis development platforms. However, the force of time is simply very strong. For this reason, we suggest that prototyping platform developers ensure that prototypes can be autonomous as a first step toward longevity.

3. ALTERNATIVE PLATFORMS

In this section, we present some alternative platforms for prototyping new media incorporating sound, but we do not attempt to survey all of the possibilities.

3.1 Smart Phones and MP3 Players

Smart phones and MP3 players are convenient because they are compact, battery powered, and incorporate significant computational power. Furthermore, some of them integrate accelerometers, touchscreens, etc., and a large number of applications have been developed to leverage these [7, 2]. For example, Figure 1 shows a smart phone mounted on a pair of headphones. The sensors in the phone are locked

Figure 1: Smart phone attached to headphones

to the motions of the head, so they can be employed for binaural synthesis and other augmented reality (AR) applications.

However, there is a value/lifespan problem with this platform. Most members of the new media community will prefer not to designate a new smart phone or MP3 player to live permanently within a prototype if it is needed for other applications. On the other hand, once a smart phone or MP3 player is older and of lesser value, its remaining lifespan will likely be quite short. Besides inevitable battery problems and possible hardware failure, smart phones and even many MP3 players are not autonomous—rather, they are designed to be connected to a service network, implying similar software change stability issues to those described in Section 2.

3.2 Satellite CCRMA

In contrast, Satellite CCRMA is another compact platform based on the power of smart phone processors, but is autonomous due to elimination of the battery and software updates. In addition, it is less expensive than the fanciest smart phones/MP3 players due to removal of unessential hardware. Furthermore, due to the presence of a standard USB bus and Linux support, it can be simply expanded and reconfigured by interfacing with Arduino, external sound interfaces, webcams, as well as (e.g. pico) video projectors. A picture of the platform is shown in Figure 2, where an Arduino Nano is stacked atop the Beagle Board-xM, which runs Satellite CCRMA via Ubuntu Linux at 1GHz. It supports floating-point operations natively and incorporates on-board Ethernet and stereo audio input/output codecs. For creating acoustic output, Satellite CCRMA can be connected to the Diamond MSP100B 4 Watts 2.0 Mini Rockers (see black speaker pair in Figure 2, left).

3.3 Small, Inexpensive, & Easy-To-Program: Microcontroller Alone

It is an interesting exercise to consider what platform is the smallest and least expensive while still being relatively easy to program. One possible example based on the Teensy microcontroller is shown in Figure 3, which we modified to operate off of a 3.3V power source by soldering the MCP1825 voltage regulator onto the underside.[2] It can be programmed over a USB connection using the Teensyduino add-on to the Arduino software environment.

The Teensy synthesizes sound by alternately turning an

[2] `http://www.pjrc.com/store/mcp1825.html`

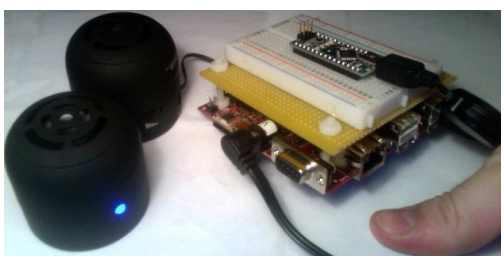

Figure 2: Satellite CCRMA

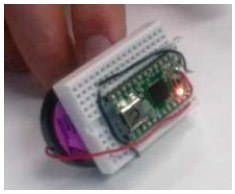

Figure 3: Teensy on breadboard (left) with 3.3V battery and loudspeaker on underside (right)

output pin on and off, which is connected to a speaker that consumes most of the energy from the 3.3V clock battery power source. By modulating the period of oscillation and pulse width, the Teensy can provide a large spectrum of fundamental frequencies and some variation in the timbre. Better control over the sound could be obtained by using a pulse width modulation pin with a low-pass filter, or better yet a commercial digital-to-analog converter (DAC) chip.

4. CAN NEW MUSICAL INSTRUMENTS GROW OLD?

In order to create a history of new media populated with actual artefacts that remain physically operable and easily demonstrable, we encourage the NIME community to take steps that allow their *new* musical instruments to grow *old*. For this reason, we believe that prototyping platforms should at least promote the creation of autonomous devices, ultimately ones which are long lived. In other words, we seek to create new media *artefacts*.[3] Perhaps we are far from the ideal, but it is interesting to consider what would be required to enable the archeology of new media. In our mind, the motivation is quite similar to that of electroacoustic music composers who wish to archive software, digital scores, paper scores, recordings, and descriptions of hardware setups [5, 6]; however, until now, there appears to have been little discussion of preservation of the hardware itself.

5. REFERENCES

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[3] Also recently there has been some ambiguity in the usage of the term "sound object" [4].