GKS DIGITAL
1396 El Camino Drive, Coquitlam, BC, V3E 2W6
Phone: 604-789-6840
Fax: 604-467-8142
Email: inquiries@gksdigital.com

October 31, 2005

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

ENSC 440 Functional Specification for the GKS Digital Hydra Octophonic Guitar Pickup

Dear Dr. Rawicz,

GKS Digital would like to submit for your consideration and approval the functional specification for the Hydra Octophonic Guitar Pickup and Chimera Modelling Software. These specifications describe the functional requirements for the final Hydra and Chimera products, with markings denoting which specifications GKS Digital is committing to complete for the first public prototype to be unveiled in January 2006. These specifications are outlined in the attached document, *Hydra Octophonic Guitar Pickup - Functional Specification*

Sincerely,

Eli Gibson CEO GKS Digital

Enclosure: Hydra Octophonic Guitar Pickup - Functional Specification

cc: Mr. Steve Whitmore, Mr. Mike Sjoerdsma, Mr. Brad Oldham

Hydra

Octophonic Guitar Pickup

Functional Specification

Management Team: Eli Gibson, CEO
Kamil Kisiel, CTO & Marketing Manager
Derek Sahota, CFO & R&D Manager

Contact: Eli Gibson eli.gibson@gksdigital.com

Submitted to: Dr. Andrew Rawicz
Mr. Michael Sjoerdsma
Mr. Steve Whitmore
Mr. Brad Oldham
School of Engineering Science
Simon Fraser University

Issued Date: October 31, 2005

Revision Number: 1.00

Executive Summary

Over the past two decades, a digital revolution in audio has shaken the professional recording industry to its foundation. The insatiable desire of musicians to create music combined with access to affordable recording technologies has caused a shift in the balance of power from the recording industry to the musician. Lower costs have caused the pool of recording artists to swell considerably and have allowed some of these home recording musicians to become superstars.

The GKS Digital Hydra Octophonic Guitar Pickup harnesses this trend, making it even easier for amateur and professional guitarists to record music at home. The Hydra is an electric guitar accessory that allows a musician to record signals from individual strings directly to a PC, and to manipulate these signals into the music of their creative fancy.

The development of the Hydra will occur in three stages. After the first stage of development, GKS Digital will have a proof of concept hardware prototype, with recording software. After the second stage of development, GKS Digital will have a proof of concept full system, with hardware, recording software and modelling software. After the third stage of development, GKS Digital will have a ready for market product, with feature complete hardware and software.

GKS Digital has committed to complete the first stage of development by mid-December, 2005, with the first public unveiling to occur in mid-January, 2006. Barring unexpected difficulties, GKS Digital intends to have the second stage of development completed by the time of the public unveiling. The timeline for the third stage of development will depend on technical and market factors, and will be determined after the first public unveiling.

GKS DIGITAL
1396 El Camino Drive, Coquitlam, BC, V3E 2W6
Phone: 604-789-6840
Fax: 604-467-8142
Email: inquiries@gksdigital.com

Table of Contents

GKS DIGITAL
1396 El Camino Drive, Coquitlam, BC, V3E 2W6
Phone: 604-789-6840
Fax: 604-467-8142
Email: inquiries@gksdigital.com

1. Introduction

The Hydra is an electric guitar accessory that allows musicians to record the sounds from individual strings directly to a personal computer (PC), and manipulate the sounds to fulfill their creative desires. The Hydra hardware can be installed in most electric guitars with minimal effort and modification to the guitar. The Hydra will come packaged with the user-friendly Chimera modelling software that allows the musician to effortlessly transform their guitar tone. The coupling of the Hydra hardware with the Chimera software will allow musicians significantly more freedom to create their music, their way.

The development of the Hydra prototype, which includes both a hardware interface to a guitar and modelling software, should be completed by January 2006. The timing for the commercial production of the GKS Digital Hydra is dependant on a number of external market factors.

1.1. *Scope*

This document describes the functional requirements for the three stages of development for the Hydra Octophonic Guitar Pickup. These requirements make up a purposive document, enumerating both the enabling and limiting features of the device. Note that these requirements are not intended to specify technical or user interface design decisions, but rather to provide a framework for making such decisions. Also note that this document is a dynamic specification, allowing for modifications based on lessons learned during design and user testing.

1.2. *Intended Audience*

This document is intended for several distinct groups. It will be used by the design team to structure technical and user interface design decisions, and to perform post-design quality verification. It will also be used by the management team and the corporate stakeholders to monitor the progress of development.

1.3. *Document Conventions*

This document specifies the functional requirements for the Hydra and Chimera products. In order to make referencing this document easier, each specification is given a specification number, denoted in the form R[#].

As this document is also intended to guide the development of the two first stages of prototype development, the document distinguishes between specifications to be met by the first prototype (denoted in black), by the second prototype (denoted in blue) and by the third prototype (denoted in green).

1.4. *Glossary*

Chimera:	GKS Digital's software package allowing recording and modelling of sound from a guitar equipped with the Hydra
Hydra:	GKS Digital's hardware interface which attaches to an electric guitar
Octophonic:	a system having eight audio channels
PC:	a Personal Computer
Piezoelectric:	a physical effect which converts mechanical stress to electrical voltages within a crystal [1]
USB:	the Universal Serial Bus is a computer industry standard bus for high speed serial communications between a device and a PC [2]

2. Requirements

2.1. *System Overview*

In a typical electric guitar the sound is produced from the metal guitar strings vibrating above a set of magnetic coils. The sum of the electric signals from the vibration of each string is sent over a conducting cable to the guitar amplifier where the signal is filtered and amplified to produce the final guitar sound.[3]

The Hydra augments the capabilities of a standard guitar by allowing the vibrations of each string to be detected individually. The signal from each string is then digitized and transmitted over a USB connection to the player's PC. The Chimera software package then allows a musician to use digital filters to change the sound of their guitar to suit their taste. The Chimera software will also interface with industry standard audio applications to allow further post-processing and mixing to create the final musical output.

2.2. *Hardware Interface Specifications*

The hardware component of the Hydra is responsible for converting the analog signals coming from each guitar string in to a digital representation and transmitting them to a PC over a USB interface.

2.2.1. 1st Iteration

R[1] The Hardware shall interface to the Universal Serial Bus (USB).
R[2] The Hardware shall still allow for an analog audio output compatible with standard instrument audio connectors.
R[3] The Hardware shall be functional automatically when connected to a compatible computer.
R[4] The Hardware shall provide one output channel for each guitar string.
R[5] The Hardware shall provide at least one output channel for the magnetic pickups.

2.2.2. 3rd Iteration

R[6] The Hardware should provide interface for an optional piezoelectric pre-amp.
R[7] The Hardware should be compatible with commonly available bridge transducers systems.
R[8] The Hardware should allow the guitar to function as a standard electric guitar.
R[9] The Hardware should not require an additional power cord or battery.
R[10] The Hardware should not affect the quality of the analog audio output.
R[11] The Hardware should be compatible with both USB1.1 and USB2.0.

2.3. *Recording Software Specifications*

The software receives data sent from the hardware interface and translates the data into a format suitable for recording and processing by computer software. The specifications for this recording software have been summarized below.

2.3.1. 1st Iteration

R[12] The Software shall install in simple manner familiar to average computer users.
R[13] The Software shall allow a user to record multiple audio streams for the digital output from each string.
R[14] The Software shall interface with industry standard music editing programs (Cubase, Sonar, Logic).

2.3.2. 3rd Iteration

R[15] The Software should provide a latency less than 10 ms from pickup to recording.
R[16] The Software should record digital audio at the professional audio standard of 24 bit 96 KHz sampling.[4]
R[17] The Software should allow recording of digital audio at data rates less than 24 bit 96 KHz sampling.

2.4. *Physical constraints*

Guitar accessories, such as the Hydra, must be minimally invasive to both the look and feel of the guitar. The functional physical constraints for the Hydra device are listed below.

2.4.1. 1st Iteration

R[18] The hardware interface shall be simple enough to be installed by a qualified guitar technician with minimal additional training and tools (e.g. a basic schematic).
R[19] The data cable shall be long enough to reach from the guitar to a nearby computer set up (minimum 3 metres).
R[20] The wiring on the guitar shall be sufficiently contained so as to not interfere with natural guitar playing.
R[21] Installation of the hardware interface shall require minimal modifications to the guitar body.

2.4.2. 3rd Iteration

R[22] The hardware interface should fit within a typical electronics compartment in an electric guitar body.
R[23] The data cable should be flexible to allow for reasonable movement by the musician playing the guitar.
R[24] The data cable should be firmly attached to the guitar to ensure the cable does not fall out during use.
R[25] The data cable should be attached so that excess strain on the cable does not damage the hardware interface.
R[26] The hardware should not detract from the visual appeal of the guitar.

2.5. *Modelling*

Digital technology has already changed the way music is made and the Chimera modelling software included with the Hydra will add a distinct new tool to the tool chest of the modern musician. The modelling software will allow the user to customize the sound of their guitar via a series of digital filters that can be applied selectively to the signal recorded onto the PC.

2.5.1. 2nd Iteration

R[27] The modelling software shall include user customizable parameters.
R[28] The modelling software shall produce roughly same output for all guitar types.
R[29] The modelling software shall allow the user to implement digital filters with selectable cut-off frequencies and bandwidths.
R[30] The modelling software shall allow the user to selectively apply a series of digital filters to the output signals.
R[31] The modelling software shall allow different sequences of filters to be applied to each of the different output signals.

2.5.2. 3rd Iteration

R[32] The modelling software should reproduce guitar sound well enough to satisfy experienced guitar player.
R[33] The modelling software should allow the musicians' playing to sound like other instruments.
R[34] The modelling software should empower the user to maximize their creative potential.
R[35] The modelling software should interface with industry standard music editing programs (Cubase, Sonar, Logic).
R[36] The modelling should be executable in real-time allowing for its use in performance.

2.6. *Documentation*

Musicians have significantly different levels of technical experience and the documentation for the Hydra must respect that. The documentation must allow users to understand the Hydra at a level sufficient to use it to create music, and must allow a technician to install the Hydra. Initially, documentation will only be provide in English, but eventually translations will be provided for the most spoken languages in the North American market.

2.6.1. 1st Iteration

R[37] A user manual shall be provided in English
R[38] A technical hardware installation manual shall be provided in English

2.6.2. 3rd Iteration

R[39] A user manual should be provided in English, French and Spanish.
R[40] A technical hardware installation manual shall be provided in English, French and Spanish.

2.7. *Regulatory and Standards Requirements*

The Hydra must operate as both a consumer and professional audio device and is thus required to fulfill a number of governmental regulations. Furthermore, in order to be marketed as a USB device, the Hydra must also meet a number of industry specifications[5].

2.7.1. 3rd Iteration

R[41] The product shall pass appropriate CSA certifications.
R[42] The hardware should pass the USB-IF Compliance Testing Program [5].

3. Conclusion

GKS Digital is committed to producing high-quality, flexible and easy to use music equipment. This document has set out the functional requirements for the Hydra and Chimera product, and specified a subset of these to be accomplished in the first two phases of development. These specifications encompass both a hardware interface to be attached to a guitar, as well as a software package to give musicians significant flexibility. GKS Digital has committed to completion of the first stage of development by mid-January, 2006. Furthermore, we intend to complete the second stage of development in this time frame as well. The development of a final product encompassing the full set of specifications will be completed at a later date.

4. References

[1] Wikimedia Contributors, 2005. Accessed: October 31, 2005. "Piezoelectricity." http://en.wikipedia.org/wiki/Piezoelectric

[2] Wikimedia Contributors, 2005. Accessed: October 31, 2005. "Universal Serial Bus." http://en.wikipedia.org/wiki/Usb

[3] Wikimedia Foundation, 2005. Accessed: October 31, 2005. "Electric Guitar." http://en.wikipedia.org/wiki/Electric_guitar

[4] Heed, Dan. 2001. "The 24-bit Field Recording Faq." http://www.24bitfaq.org/#Q0_1_1

[5] USB Implementers Forum, 2005. "USB.org – Logo." http://www.usb.org/developers/compliance/logo/

