FYP Proposal

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Class: 4th Year Electronic & Computer Engineering

EE/IT: Electronic Engineering Department

Project Supervisor: Dr. Martin Glavin (pre-arranged)

Project Title: Wireless guitar digital effects system.

Overview:

For final year project I propose to research and develop a complete wireless solution for the electric guitar.

The first phase is an embedded effects unit to plug into an electric guitar. This unit will convert the analogue signal from the guitar to digital, perform DSP to apply selected digital audio effects to the sound signal in real-time. Analogue effects have been hugely popular with guitarists for years and have help shape music over the last half-century. However in recently, due to significant advances in digital electronics, guitar effects are making the switch to digital processing, due to the practicality and flexibility offered. It is proposed to use an FPGA to implement the audio DSP; this will give a performance advantage over a dedicated digital signal processor. Initially the following effects will be implemented:

- Delay
- Distortion
- Equaliser

These employ the three fundamental principles behind the vast majority of guitar effects - time shift, amplification and frequency filtering. Using these primary principles a whole database of different effects is envisaged.

The second phase is a wireless system. In a conventional design one cable carries the clean analogue signal from guitar to the group of effects units. A second cable carries the output signal from the circuit of effects to the amplifier. The proposal is to setup a high bandwidth, low latency digital wireless link to transfer the signal from the audio

DSP at the guitar, to the amplifier. This will carry the signal after effects have been applied at the guitar, to a digital to analogue converter at the amplifier.

The third phase is to construct a pedal board to control which effects are turned on or off in any instant. This will also be a wireless application. It will consist of a low bandwidth digital link sending on / off data of pedal board foot-switches to the signal processor, indicating which combination of effects in memory should be turned on or off at any instance.

These wireless solutions will eliminate the need for countless audio and power leads that can clutter up an already crowded stage or practice area.

Important points to consider:

- Power consumption must be minimal as wireless devices will be battery powered.
- Full system latency must be very low. (< 10ms)
- Wireless audio link must be of very high quality to outperform conventional wired methods.
- Wireless links must be 100% reliable, hard timing constraints to be met.

Possibility for extension:

- Building on three base effects, create a vast databank of different effects.
- Improve the quality and reliability of the high-quality digital guitar to amplifier link.
- Extend the idea of on / off pedals for control, to variable pedals that can send a positional reading to the effects processor.
- Create a basic operating system to control the manner in which the pedal board controls the recalling of the effects stored in memory, allowing the user to easily control the selection of different effects as well as altering and storing of effect parameters.
- Research way to minimise power use in wireless devices.
- PC link as further wireless node in the system. Numerous possibilities including recording software, download of new effects or retransmission.