SOUND GATES

Projectplan

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

Outline

- Introduction
- Generative music
- Soundgates
- Technologies
- Workplan

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Introduction

Music

- **Traditional:**
  Musicians perform and people perceive music

- **Trend***:*
  Interact with music (even without knowledge)
  - Cheering and shouting at a concert
  - Guitar Hero, Rockband, DJ Hero, Singstar, …

2 Level of sound generation

- **Goal:**
  Generate music in Hardware on a FPGA

- **Level 1:**
  Musician connects components to generate sounds and melodies

- **Level 2:**
  User interacts with system at runtime to modify the output
  - Motion Sensors
  - 3D depth camera (i.e. Kinect)

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Generative music

Approaches to generative music

- Creative / Procedural
- Interactive / Behavioural

Approaches to generative music

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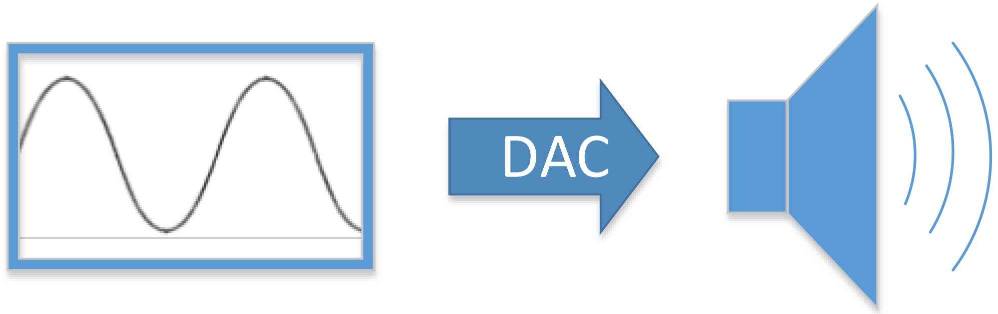
Creative / Procedural

- **Goal:**
  Generate music from precomposed options
- Musician writes song which consists of different parts
  - parts are exchangeable and randomly played
  - generates every time a new song
- ie. “Mozarts Musical Dicegame“
  - next played part was randomly chosen by rolling a dice

Approaches to generative music

- Creative / Procedural
- Interactive / Behavioural

Generate Sound on a digital System - Simple synthesizer



Interactive / Behavioural

- Results from processes without discernable musical inputs
  - uses:
    synthesized music
- Process of music generation/manipulation is fully controlled by user input and interaction
  - input modified with sensors

Soundgates

Soundgates

- Editor
- Simulator
- COSMIC

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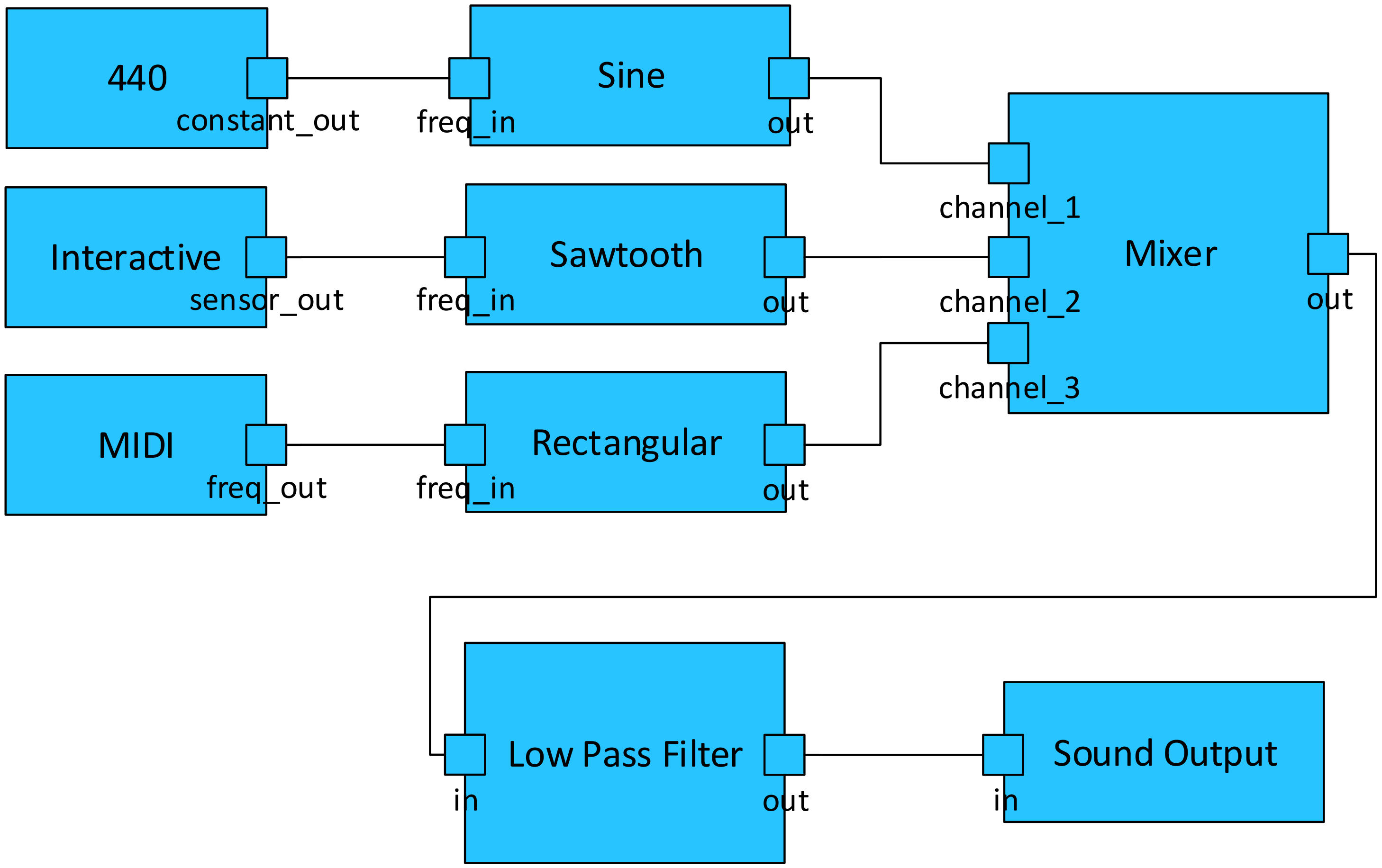
Editor

- Musician builds/loads a patch
  - consists of sound-components and connections

- Sound-components
  - wave generators (sine, sawtooth, rectangular)
  - arithmetic functions (i.e. addition, multiplication)
  - filters (i.e. low pass)
  - mixers
  - composite sound components

Example patch



Editor functions

- Make sound component public
  - possible to modify at runtime with sensors

- Export patch to VHDL code
  - and synthesize it to Bitstream

- Validate patch
  - constraints
    - i.e. every port has an input

Soundgates

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Simulator

- **Problem:**
  Testing the output is not possible until VHDL code is synthesized

- **Solution:**
- Test the developed system on PC
  - Every sound component will be implemented in SW & HW

Soundgates

- Editor
- Simulator
- COSMIC

COSMIC

- **Co**mputer **S**cientists **M**aking Mus**ic**
- The generated Bitstream is put on an FPGA
- Performer maps sensors to interfaces
  - starts session by pushing a button
- Creates input values with sensors
  - music will be generated / modified

Technologies

Graphical Modeling Framework (GMF)

- A "Model Driven Software Development" approach for graphical editors
- Specify Metamodel and generate software
  - parts and rules which are needed to create valid patches
- **Used for:**
  Create graphical editor to build patches

ReconOS

- Model applications using software and hardware threads on an FPGA
  - Posix-like abstraction (mailboxes, semaphores, …)
  - communication between threads abstracted by method calls

- **Used for:**
  Sensor input comes via IPC and is processed in software
  - modifies parameters of HW

Open Sound Control (OSC)

- Message based communication protocol
  - developed for communication between computer systems and sound synthesizers
- OSC message modifies parameters
  - i.e.
    /synthesizer1/oscillators/sine/freq “int32” 440
- Independent of transport protocol

- **Used for:**
  Sensors will send OSC messages to FPGA system to modify parameters

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Workplan

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Agile inspired development process

- Split into Hardware- and Software Groups
  - "Cross testing"
- 5 milestones
  - each consists of a set of tasks
  - approximately five to six weeks per milestone
- "Github" for versioning and sharing of code
- "Redmine" to represent milestones and tracking of tasks and bugs
- Functional system at the end of every milestone

Milestones

1. Prototyping infrastructure / environment
   - fundamental infrastructure is prototyped
   - no direct communication between them

2. Prototype of a digital synthesizer
   - basic digital synthesizer can be modeled with the editor
   - transform patch to HDL description

Milestones

3. Polishing environment
   - every planed component is implemented
   - create Android application to stream sensor data to the COSMIC system

4. System integration and benchmarking
   - evaluate system limits

Milestones

5. Documentation, Testing, Presentation
   – polishing phase

Thank you for your attention –

Any comments, hints, questions?

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Backup

Open Sound Control (OSC) - Datatypes

- int32
- float32
- OSCString
- OSCTimetag
- OSCBlob

Open Sound Control (OSC)

- Advantage:
  - higher speed than midi
    - larger datatypes and float values
  - can be send via ethernet
  - “Internet-Jam”
- Disadvantage:
  - namespace does not follow any standard