Modular LED Matrix

Team GUILED

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Recall the Project Goals and Deliverables

RGB LED Matrix Display
1) Model-based
2) Modular and Scalable
3) Configurable

Deliverables:
1. Matrix Display Demo: 16x16 LED matrices working in tandem.
2. PC GUI: To configure matrices
3. KL25Z Firmware: Base, Multiplexed, SPI
4. Simulator FW/GUI: Graphical WS2812B Protocol Analyzer
Feasibility/Interactive GUI

- System Setup
- Feasibility Analyzer
- LED Editor

USER
- User Input

HARDWARE
- LED Matrices / KL25Z

GUI
- Feedback
- Input
- Output
Drawing Canvas on 16x16 (Multiplexing)
KL 25 Z

Data Pin 1

Address Pins 1-3

Data Pin 2
Drawing Canvas

Multiplexer challenges:

- Scalability
- Timing
- "Stale" data problem

<Video>
Drawing Canvas on 16x16 (SPI)
Communication Challenges

- Timing
- Memory Constraint
- 2 Step Handshake

<Video>
State Machine/Communication Protocol

**Master**
- Listen to incoming packets
  - StartSeq = 254,70/
  - Start DMA
- Transfer data to slave
  - Ack = 249/
  - Ack != 249/

**Slave**
- Receive data from Master
  - Address = Self/
  - true/
  - Transmit Data to Next Slave
- Start DMA
  - true/
  - Address != Self /
But How To Test Without Hardware?

http://code-worrier.com/how-to-be-stuck/
Basic Process Flow

Original Image ➔ Scaled Image ➔ Actual LED Matrix

Serial

KL25Z

8 Parallel Lines

http://logo-timeline.wikia.com/wiki/File:Microsoft_logo.svg
Process Flow with Simulator

Original Image → Scaled Image → Simulated Image

Serial

KL25Z → Saleae

8 Parallel Lines
WS2812B Protocol Analyzer

1. Export to CSV
2. Parse and Visualize with Processing

- Measurements:
  - Width: 1.000000 μs
  - Period: 1.250000 μs
  - Frequency: 800.000 kHz
  - T1
  - T2
  - |T1 - T2| = # # #

- Analyzers:
  - LED Strip 0
  - LED Strip 1
  - LED Strip 2
  - LED Strip 3
  - LED Strip 4
  - LED Strip 5
  - LED Strip 6
Process Flow with Simulator

Original Image → Scaled Image → Simulated Image

Serial → KL25Z → Saleae

8 Parallel Lines
Didn’t Work with KL25Z Sniffer :(

Original Image  
Scaled Image  
Simulated Image

Serial  
KL25Z  
Serial

8 Parallel Lines
Another Example

Original Image

Scaled Image

Simulated Image
Challenges

● Hardware - Making the Matrices
● Model-based design in schedule constraints
● Version Control, uniform protocols
● Synchronizing communications
Potential Next Steps

● Dynamic Feasibility
● Get the Simulator Working!
Recall the Project Goals and Deliverables

RGB LED Matrix Display
1) Model based Design
2) Modular and Scalable
3) Configurable

Deliverables:
1. Matrix Display Demo: 16x16 LED matrices working in tandem.
2. PC GUI
3. KL25Z Firmware -> [https://github.com/antoniorohit/GUILED](https://github.com/antoniorohit/GUILED)
4. Simulator FW/GUI
Acknowledgements

Open Source SW/FW
- WS2811 library for KL25z (Ned Konz) [Apache License]
- Processing (https://processing.org) [Creative Commons]
- Logic sniffer (OLS) [GPL v2]
- KLMZ Logic Logger FW (Erich Styger) [Completely Open]