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forward together · saam vorentoe · masiye phambili

Computer Systems / Rekenaarstelsels 245

Lecture 27

Emulator Display Optimisation/
Emuleerder Vertooneenheid Optimerings

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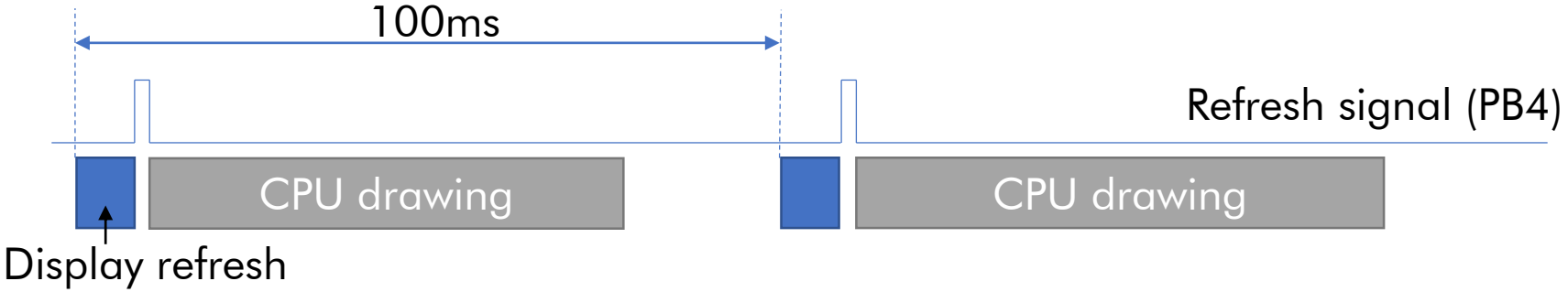
Emulator Refresh signal
Emuleerder verfrissingssein

- The emulator “display controller” will refresh the display every 100ms (10Hz)
- Emulator will output a pulse on PB4 after completing a refresh of the display
- Use this signal to synchronise drawing to the frame buffer
  - hint: use an external interrupt – GPIO_EXTI4 – and in the interrupt handler, set a flag: refresh = 1;
  - In the main function: if (refresh) { …draw to screen… refresh = 0; }



Emulator Display Optimizations
Emuleerder vertoon optimerings

- Perform 32-bit read/write instead of bytes
  - LDRB (load byte) and LDR (load 4 bytes) takes the same amount of time to execute. But LDR loads 4x more data
  - (same with STRB and STR)
  - Make sprite width a multiple of 4. Instead of

```
for (int w = 0; w < 20; w++) {…}
```

do

```
for (int w = 0; w < 5; w++) {…}
```

← but with 32-bit read write operations

Emulator Display Optimizations
Emuleerder vertoon optimerings

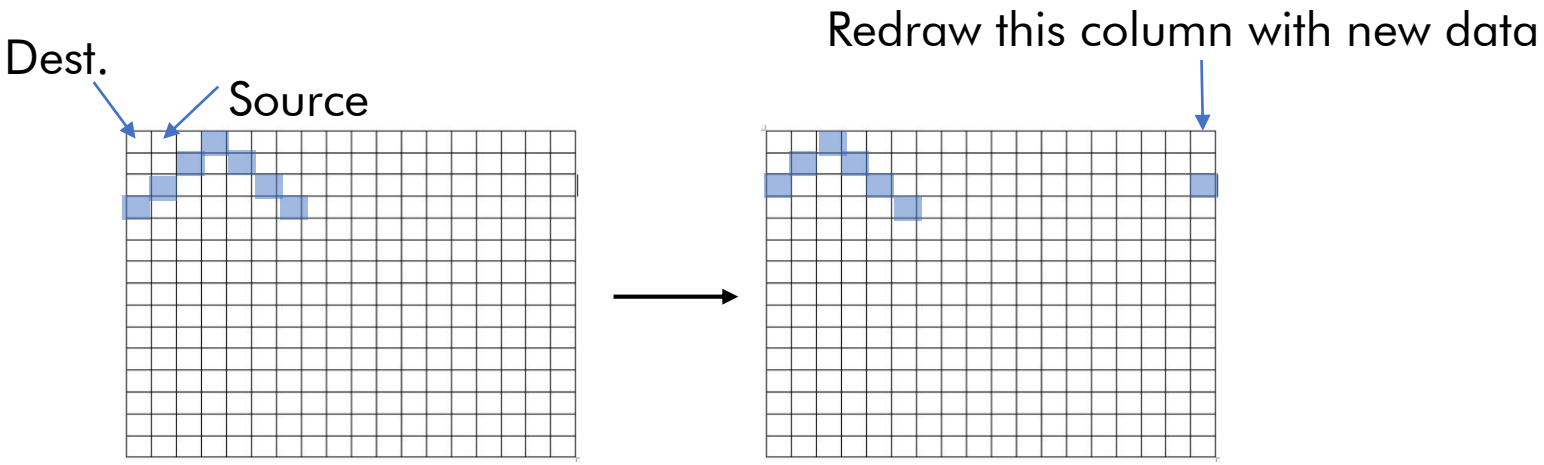
- Use memory-to-memory DMA for
  - Clear screen
  - Shift screen left
  - Shift screen up

- Clear screen:
  - Source address = address of value to clear screen with
  - Destination address = start of screen
  - Increment only destination address
  - Number of data = width*height

  - Increase performance further by using word (32-bit) transfers
  - Source address contains 4 pixels values with clear screen value (i.e. 0x0F0F0F0F)
  - Number of data = width*height/4

Emulator Display Optimizations
Emuleerder vertoon optimerings

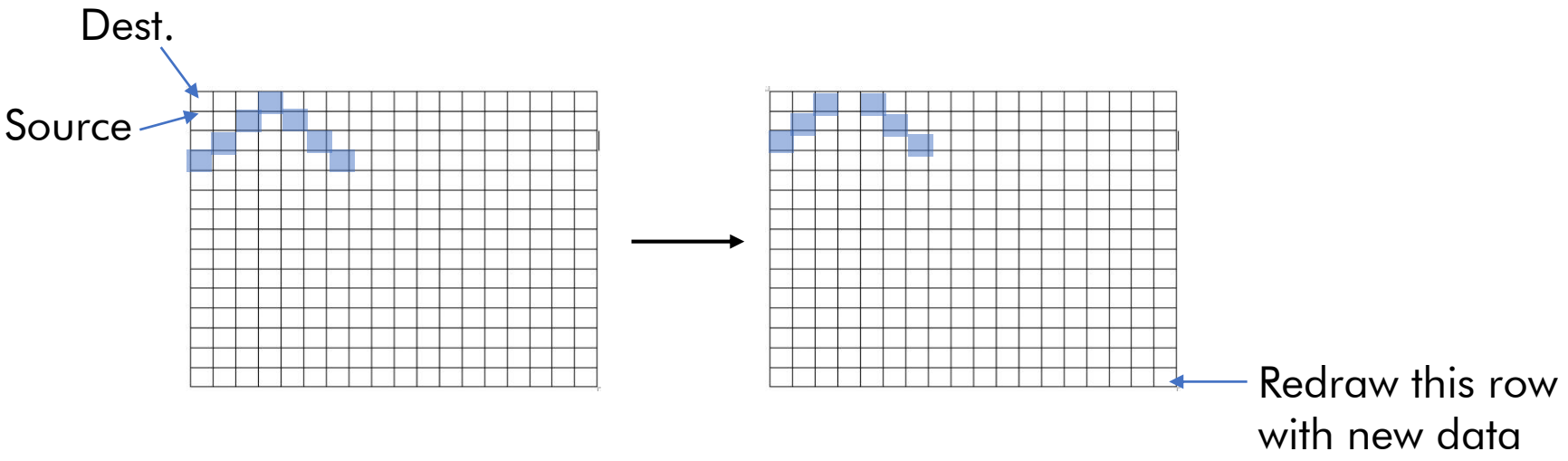
- Use memory-to-memory DMA to shift screen left:
  - Destination address = start of screen memory
  - Source address = start of screen memory + horizontal shift amount
  - DMA increment source and destination
  - Number of data = width*height – horizontal shift amount
  - Redraw the right-most columns



- Increase performance further by using 32-bit transfers
- Shift amount can only be multiples of 4
- Number of data = (width*height – horizontal shift amount)/4

Emulator Display Optimizations
Emuleerder vertoon optimerings

- Use memory-to-memory DMA to shift screen up:
  - Destination address = start of screen memory
  - Source address = start of screen memory + (vertical shift amount * width)
  - DMA increment source and destination
  - Number of data = width*(height – vertical shift amount)/4
  - (use 32-bit transfer)
  - Redraw the bottom rows



Emulator Display Optimizations
Emuleerder vertoon optimerings

- Using memory-to-memory DMA for display operations:
  - To know if the operation completed, use DMA interrupt:
  - Set ‘done = 1;’ flag in interrupt handler
  - Wait for done flag in main program