SSE3052: Embedded Systems Practice

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SAMSUNG
Google
Create
Play
HUAWEI

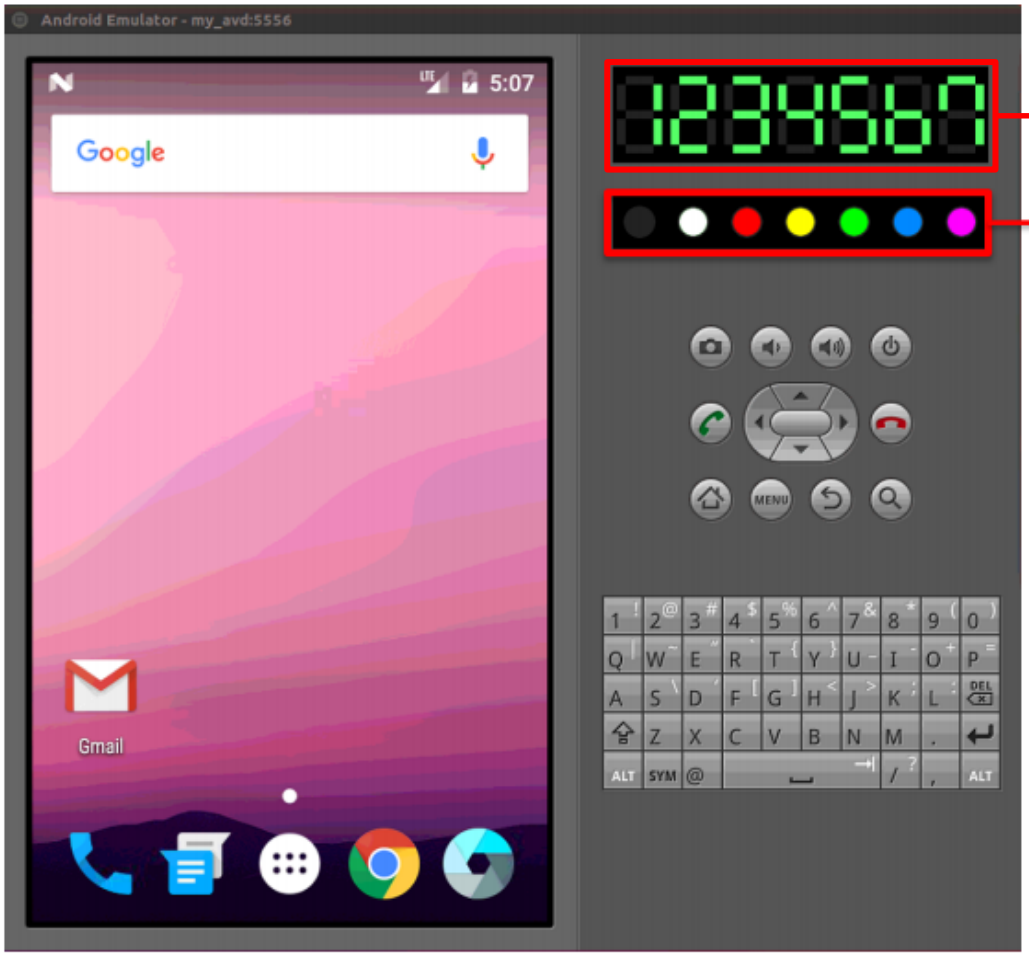
Attach new device

Agenda

1. Attach 7 segment display to (virtual) device.
2. Write a device driver.
3. Write a system call & user program to manipulate t he display.

Attach Virtual Device

- Attach new virtual devices (7 SEGMENT, LED)



7 SEGMENT

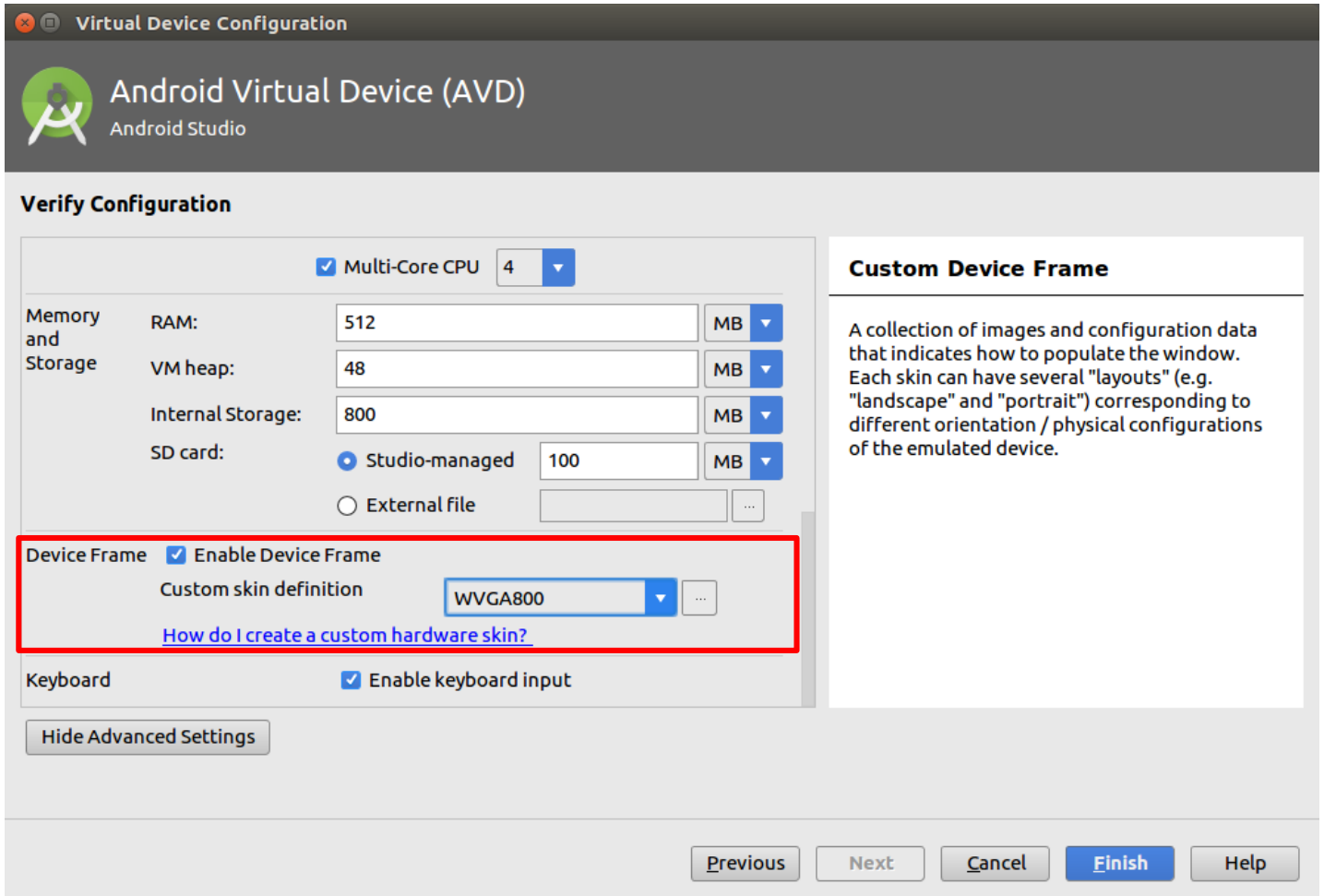
LED

Use system call to operate these devices!

Attach Virtual Device

- Download virtual_device.zip from i-Campus
- Unzip the downloaded file
  - goldfish_kernel_with_led.patch
    - Kernel patch (device drivers) for the virtual device
  - qemu_devices_with_led.patch
    - Emulator (QEMU) patch for the virtual device
  - skin_android-24_WVGA800_with_led.tgz
    - Skins of the virtual device

(Menu) Tools – AVD Manager



Update Skin

- Untar "skin_android-24_WVGA800_with_led.tgz".
  - Note: The file contains image files of virtual devices' display.
- Untar & place all image files to relevant directory.
  - `~/Android/Sdk/platforms/android-24/skins/WVGA800/`

External Emulator (QEMU)

- Download emulator source code .
  - (We do not use the emulator in SDK.)

```
$mkdir ~/bin
$export PATH=~/bin:$PATH
$curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo
$chmod a+x ~/bin/repo
$mkdir emu-2.2-release
$cd !$      -- this is equal to $cd emu-2.2-release
$repo init -u https://android.googlesource.com/platform/manifest -b emu-2.2-release
$repo sync
```

QEMU Patch for the new Devices

- Place "qemu_devices_with_led.patch" under `emu-2.2-release/external/qemu`
- Patch.

```
$cd ~/emu-2.2-release/external/qemu
$patch –p1 < qemu_segment.patch
```

- Build.

```
$./android-rebuild.sh
```

Run QEMU

- Run new emulator.

```
$export ANDROID_SDK_ROOT=/path/to/android-sdk
  -ex) $export ANDROID_SDK_ROOT=~/Android/Sdk
$/path/to/qemu/objs/emulator -avd [avd-name]
  -ex) $~/emu-2.2-release/external/qemu/objs/emulator –avd my_avd
```

Device Driver

(You won't need to write a device driver.. yet..)

- Place "goldfish_kernel_with_led.patch" under `goldfish`.
- Patch

```
$patch -p1 < goldfish_kernel_with_led.patch
```

- Build (modified! Read carefully)

```
$export ARCH=x86_64
$export CROSS_COMPILE=~/x86_64-linux-android-4.9/bin/x86_64-linux-android-
$make x86_64_emu_defconfig
$make menuconfig
=>check the "device drivers/Misc devices/Android Goldifsh 7 segment, LED"
$make -j4
$cp arch/x86/boot/bzImage ~/Android/Sdk/system-images/android-24/google_apis/x86_64/kernel-qemu
```

Boot Error

- If your emulator shows below errors,

```
esp@esp:~$ ~/emu-2.2-release/external/qemu/objs/emulator -avd my_avd
ERROR: Invalid GPU mode 'software', use one of: on off host guest mesa swiftshader
```

```
esp@esp:~$ ~/emu-2.2-release/external/qemu/objs/emulator -avd my_avd
sh: 1: glxinfo: not found
sh: 1: glxinfo: not found
emulator: WARNING: Classic qemu does not support SMP. The hw.cpu.ncore option from your config file is ignored.
libGL error: unable to load driver: swrast_dri.so
libGL error: failed to load driver: swrast
X Error of failed request:  BadValue (integer parameter out of range for operation)
  Major opcode of failed request:  154 (GLX)
  Minor opcode of failed request:  24 (X_GLXCreateNewContext)
  Value in failed request:  0x0
  Serial number of failed request:  21
  Current serial number in output stream:  22
QObject::~QObject: Timers cannot be stopped from another thread
```

- Modify the "~/.android/avd/my_avd.avd/config.ini"
  - hw.gpu.mode=guest

goldfish/drivers/misc/goldfish_segment.c

Device Driver

goldfish_segment.c

```
static int goldfish_segment_probe(struct platform_device *pdev)
{
…
}

static int goldfish_segment_remove(struct platform_device *pdev)
{
…
}

static const struct of_device_id goldfish_segment_of_match[] = {
…
};
MODULE_DEVICE_TABLE(of, goldfish_segment_of_match);

static const struct acpi_device_id goldfish_segment_acpi_match[] = {
…
};
MODULE_DEVICE_TABLE(acpi, goldfish_segment_acpi_match);
```

goldfish_segment.c

```
static struct platform_driver goldfish_segment_device = {
    .probe    = goldfish_segment_probe,
    .remove   = goldfish_segment_remove,
    .driver   = {
        .name = "goldfish_segment",
        .of_match_table = goldfish_segment_of_match,
        .acpi_match_table = ACPI_PTR(goldfish_segment_acp
i_match),
    }
};
module_platform_driver(goldfish_segment_device);
```

Platform Driver

```
<linux/platform_device.h>
struct platform_driver {
  int (*probe)(struct platform_device *);
  int (*remove)(struct platform_device *);
  void (*shutdown)(struct platform_device *);
  int (*suspend)(struct platform_device *, pm_message_t state);
  int (*resume)(struct platform_device *);
  struct device_driver driver;
  const struct platform_device_id *id_table;
};
```

…

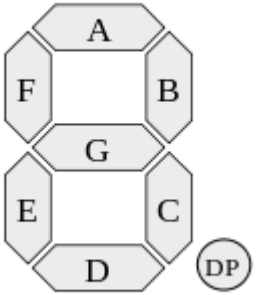
```
#define module_platform_driver(__platform_driver) \
  module_driver(__platform_driver, \
                platform_driver_register, \
                platform_driver_unregister)
```

goldfish_segment.c

```
#define GOLDFISH_SEGMENT_READ(data, addr) \
  (readl(data->reg_base + addr))
#define GOLDFISH_SEGMENT_WRITE(data, addr, x) \
  (writel(x, data->reg_base + addr))
…
GOLDFISH_SEGMENT_WRITE( data,SEGMENT0, 0x24);  // "1"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT1, 0x5d);  // "2"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT2, 0x6d);  // "3"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT3, 0x2e);  // "4"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT4, 0x6b);  // "5"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT5, 0x7a);  // "6"
GOLDFISH_SEGMENT_WRITE( data,SEGMENT6, 0x27);  // "7"
```

7 Segment Display

- 0x24? 0x5d? 0x6d?...

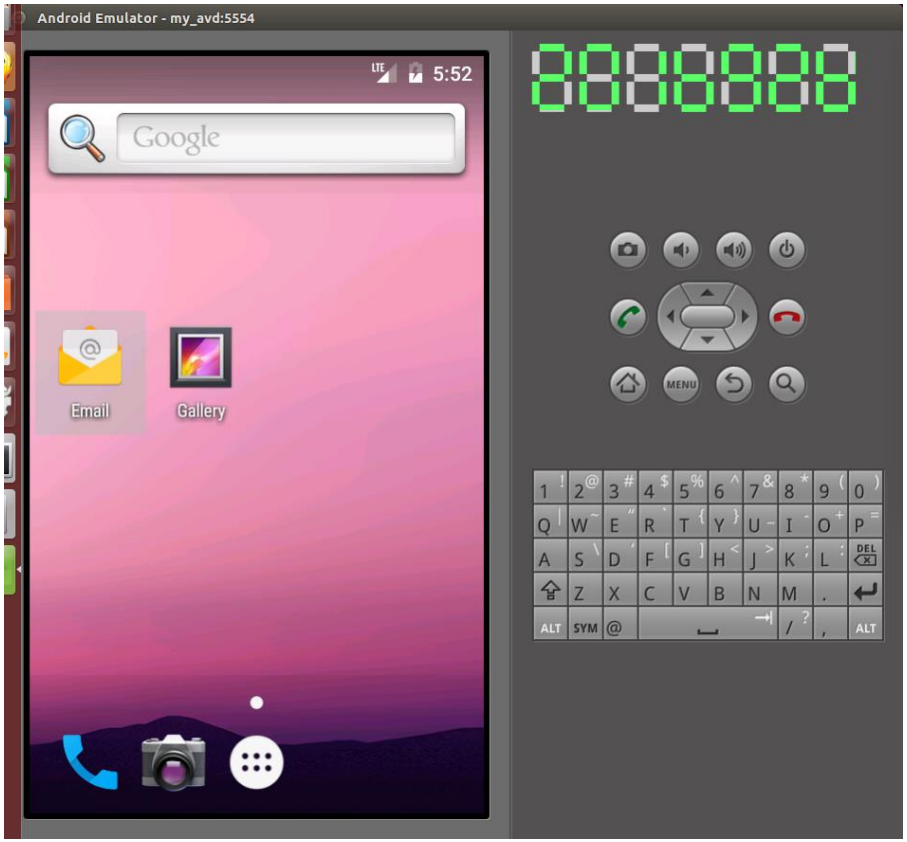


A = 0000 0001b	"1" = 0010 0100b = 0x24
F = 0000 0010b	"2" = 0101 1101b = 0x5d
B = 0000 0100b	"3" = 0110 1101b = 0x6d
G = 0000 1000b	…
E = 0001 0000b	…
C = 0010 0000b	
D = 0100 0000b	

Exercise

1. Write a system call that takes an integer as a parameter and displa y the integer to 7 segment display.
   - If an integer is larger than 9999999, then display "0000000".
2. Write a program that invokes the implemented system call with p arameter input from a user.
   - `int main(int arcs, int *argv[])`
   - `Ex) ./a.out 2019326`
   - `Ex) ./a.out 1000`

- Do you remember,
  - how to add new system call?
  - how to compile new user program?
  - how to move executable binary?
  - Please check the last lecture…


Android Emulator - my_avd:5554
5:52
Google
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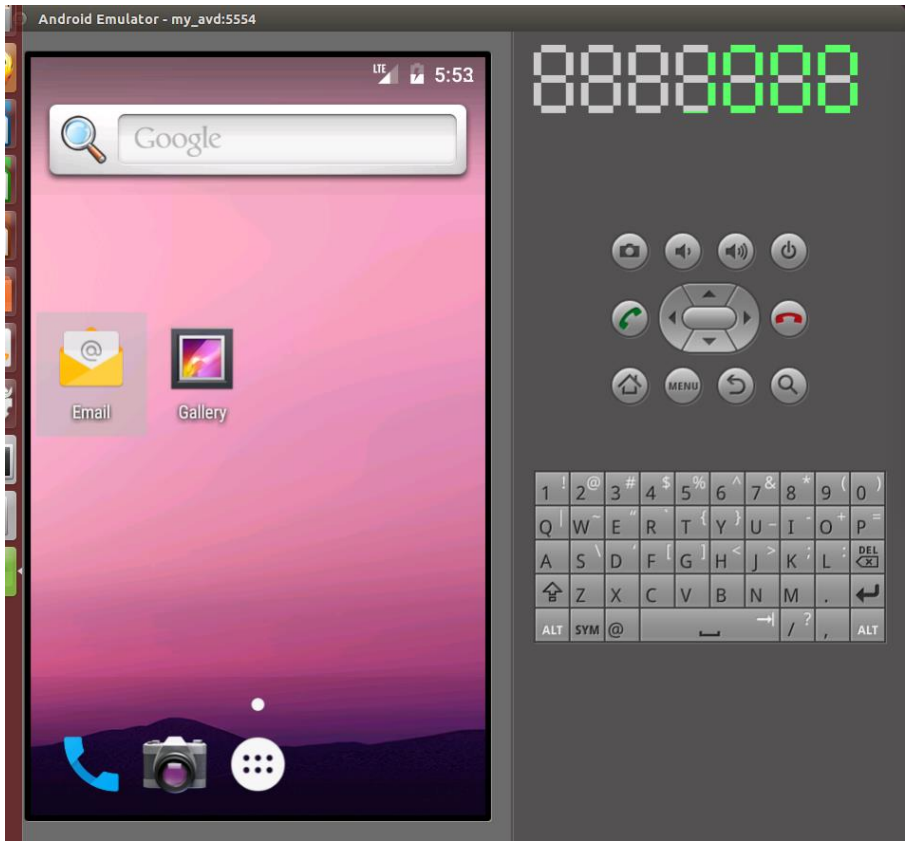
Gallery
MENU


Android Emulator - my_avd:5554
5:53
Google
Email
Gallery
MENU

Lab Report

- Format: yourstudentID_lab3.pdf

  You must include the result (captured emulated device)

  Upload to i-Campus

  Deadline: 3/29 (Sun.) 23:59