**repo: **

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int_stack + USB-key – character device with hot-plug protection

Feature	Implementation
Electronic key	USB VID:PID **31B2:5075** (KTMicro audio dongle)
Dynamic memory	`krealloc()` stack array
Thread safety	single `mutex` around push/pop/ioctl
file_operations	same as Lab 4 (`open` , `release` , `read` , `write` , `unlocked_ioctl`)
Hot-plug logic	`usb_driver → probe()/disconnect()` create/destroy **/dev/int_stack**
Error handling	no key → CLI prints `ERROR: USB key not inserted` ; other errors identical to Lab 4

```
static const struct usb_device_id key_tbl[] = {
        { USB_DEVICE(0x31B2, 0x5075) }, {}
};
MODULE_DEVICE_TABLE(usb, key_tbl);

static int  key_probe(...)      { return stack_dev_create(); }
static void key_disconnect(...) { stack_dev_destroy(); }
```

kernel_stack – CLI (updated)

- Commands unchanged: `set-size`, `push`, `pop`, `unwind`.
- Extra guard: if `/dev/int_stack` is absent (`open → ENOENT`) the tool exits with `ERROR: USB key not inserted`.

Scenario	Result
key absent	every command → error, exit 1
key present	full Lab 4 behaviour
remove key while open fds closed	device node disappears, stack data kept

```
int fd=open(dev,flags);
if(fd<0 && errno==ENOENT){fputs("ERROR: USB key not
inserted\n",stderr);exit(1);}
```

Build & load

```
ezzy A > □ ~/linux_course/bldd/lab-5
>> make
make -C /usr/lib/modules/6.14.5-arch1-1/build M=/home/ezzy/linux_course/bldd/lab-5 modules
make[1]: Entering directory '/usr/lib/modules/6.14.5-arch1-1/build'
make[2]: Entering directory '/home/ezzy/linux_course/bldd/lab-5'
make[2]: Leaving directory '/home/ezzy/linux_course/bldd/lab-5'
make[1]: Leaving directory '/usr/lib/modules/6.14.5-arch1-1/build'
```

Full test run

```
ezzy A > □ ~/linux_course/bldd/lab-5
>> lsusb | tail -10
Bus 001 Device 003: ID 1a40:0101 Terminus Technology Inc. Hub
Bus 001 Device 004: ID 0408:1040 Quanta Computer, Inc. ov9734_techfront_camera
Bus 001 Device 005: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153 Gigabit Ethernet Adapter
Bus 001 Device 006: ID 1532:0083 Razer USA, Ltd RC30-0315, Gaming Mouse [Basilisk X HyperSpeed]
Bus 001 Device 007: ID 320f:5088 Telink Wireless Gaming Keyboard
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 003 Device 003: ID 1358:c123 Realtek Bluetooth Radio
Bus 003 Device 004: ID 27c6:5125 Shenzhen Goodix Technology Co.,Ltd. Goodix Fingerprint Device
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub

ezzy A > □ ~/linux_course/bldd/lab-5
>> sudo ./kernel_stack set-size 2
ERROR: USB key not inserted

ezzy A > □ ~/linux_course/bldd/lab-5
>> lsusb | tail -10
Bus 001 Device 004: ID 0408:1040 Quanta Computer, Inc. ov9734_techfront_camera
Bus 001 Device 005: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153 Gigabit Ethernet Adapter
Bus 001 Device 006: ID 1532:0083 Razer USA, Ltd RC30-0315, Gaming Mouse [Basilisk X HyperSpeed]
Bus 001 Device 007: ID 320f:5088 Telink Wireless Gaming Keyboard
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 003 Device 003: ID 1358:c123 Realtek Bluetooth Radio
Bus 003 Device 004: ID 27c6:5125 Shenzhen Goodix Technology Co.,Ltd. Goodix Fingerprint Device
Bus 003 Device 008: ID 31b2:5075 KTMicro KT USB Audio
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub

ezzy A > □ ~/linux_course/bldd/lab-5
>> sudo ./kernel_stack set-size 2
```

Push / Pop / Unwind & key removal

```
ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack push 1

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack push 2

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack push 3
ERROR: stack is full

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack pop
2

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack pop
1

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack pop
NULL

ezzy Λ  ~/linux_course/bldd/lab-5
)) lsusb | tail -10
Bus 001 Device 003: ID 1a40:0101 Terminus Technology Inc. Hub
Bus 001 Device 004: ID 0408:1040 Quanta Computer, Inc. ov9734_techfront_camera
Bus 001 Device 005: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153 Gigabit Ethernet Adapter
Bus 001 Device 006: ID 1532:0083 Razer USA, Ltd RC30-0315, Gaming Mouse [Basilisk X HyperSpeed]
Bus 001 Device 007: ID 320f:5088 Telink Wireless Gaming Keyboard
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 003 Device 003: ID 1358:c123 Realtek Bluetooth Radio
Bus 003 Device 004: ID 27c6:5125 Shenzhen Goodix Technology Co.,Ltd. Goodix Fingerprint Device
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub

ezzy Λ  ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack pop
ERROR: USB key not inserted
```

```
ezzy Λ     ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack push 3
ERROR: stack is full

ezzy Λ     ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack unwind
ERROR: USB key not inserted

ezzy Λ     ~/linux_course/bldd/lab-5
)) echo "Here I connect USB"
Here I connect USB

ezzy Λ     ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack unwind
2
1

ezzy Λ     ~/linux_course/bldd/lab-5
)) sudo ./kernel_stack pop
NULL

ezzy Λ     ~/linux_course/bldd/lab-5
)) |
```