數位系統設計作業－4
DW8051-紅外線發射器

溫進坤

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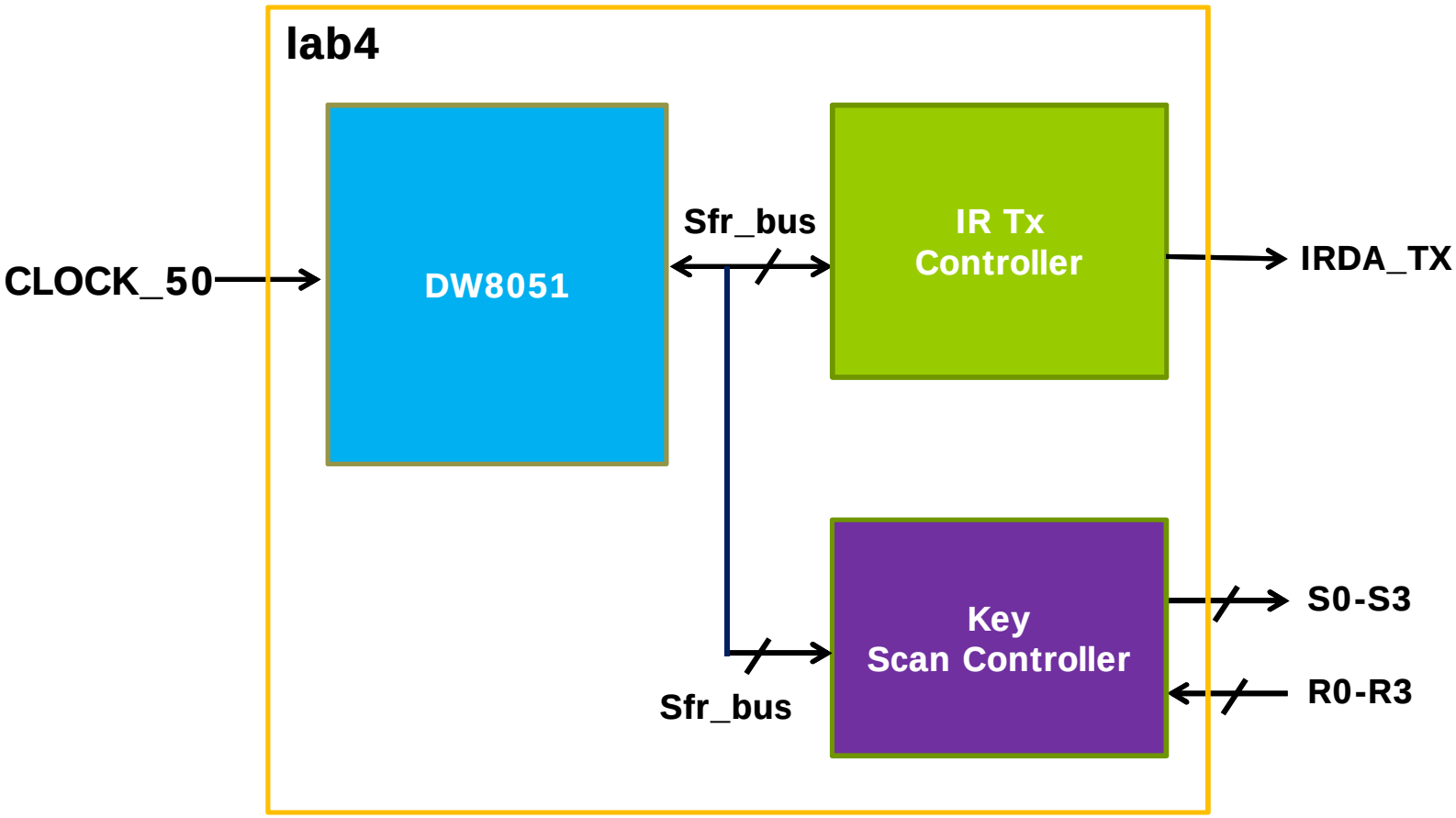
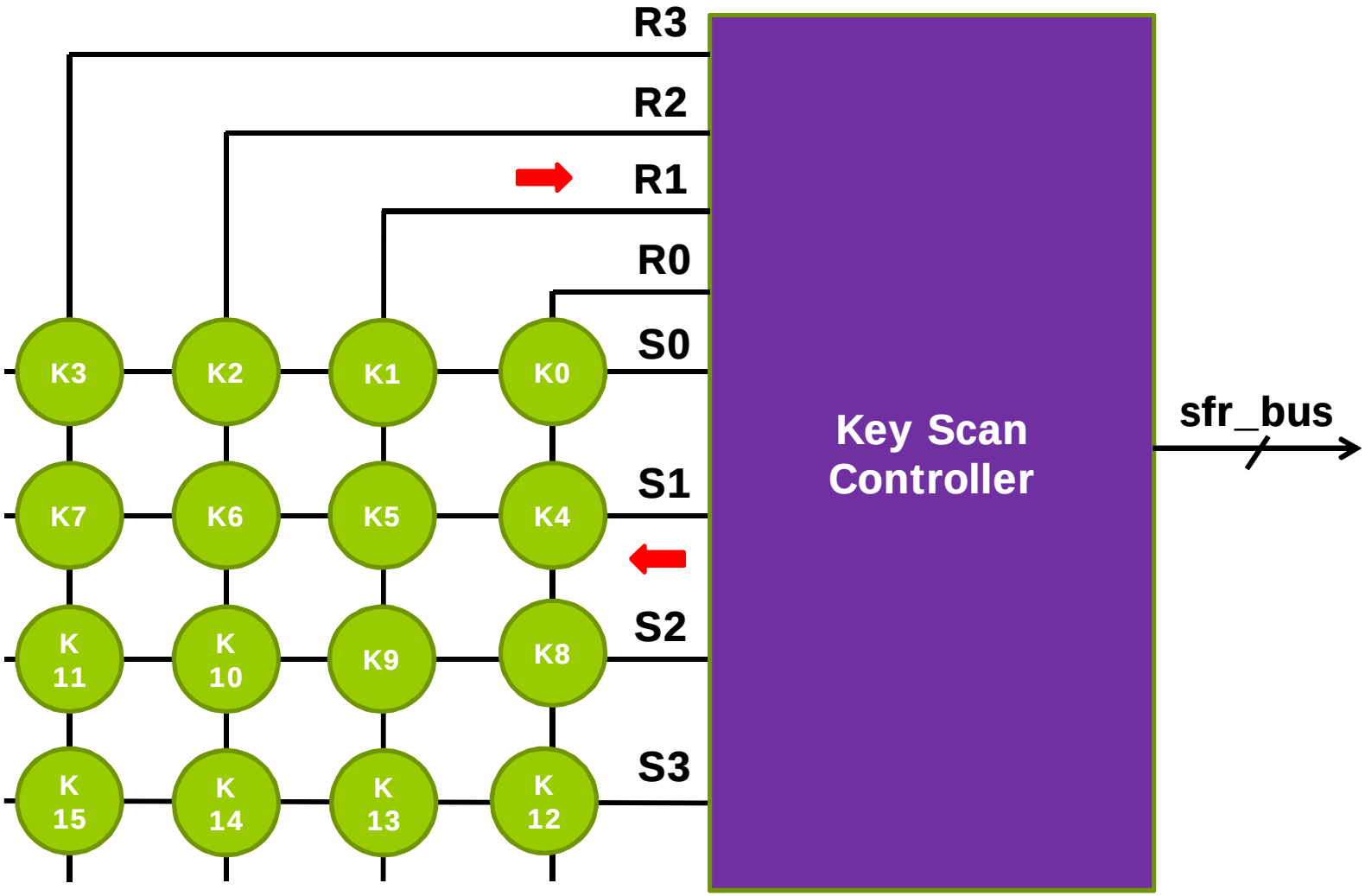
題目功能

1. 設計一個DW8051的IR TX 及Key Scan IP
2. 每次按下按鍵後，發射按鍵對應的紅外線客戶及按鍵碼資料。
3. 當按鍵按下超過110ms後，應重複送出repeat code，直到放開為止。
4. IR TX 頻率38KHz，按鍵debounce 15ms，按鍵掃描頻率1000Hz。
5. 使用同步式設計，always中不能使用CLOCK_50M或RESET以外的訊號當CLOCK使用。

系統方塊圖


lab4
CLOCK_50
DW8051
Sfr_bus
IR Tx
Controller
IRDA_TX
Sfr_bus
Key
Scan Controller
S0-S3
R0-R3

Key Scan Controller

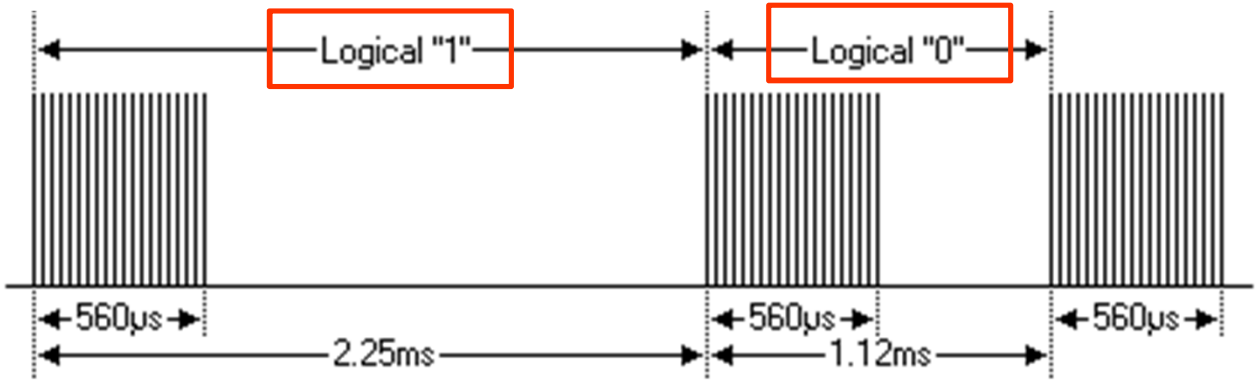


Key Scan Controller Register Map

SFR Addr	Description	Type	Note
0xEA	Key Control Byte	R/W	Bit0:key_en , 1:key enable Bit4:key_pressed , 1:key pressed Bit5:key_repeat , 1:key pressed over 110ms
0xEB	Key Map 1 Byte	R	Bit0:K0 , 1 is key0 pressed ,0 is release Bit1:K1 , 1 is key1 pressed ,0 is release Bit2:K2 , 1 is key2 pressed ,0 is release Bit3:K3 , 1 is key3 pressed ,0 is release Bit4:K4 , 1 is key4 pressed ,0 is release Bit5:K5 , 1 is key5 pressed ,0 is release Bit6:K6 , 1 is key6 pressed ,0 is release Bit7:K7 , 1 is key7 pressed ,0 is release
0xEC	Key Map 2 Byte	R	Bit0:K8 , 1 is key8 pressed ,0 is release Bit1:K9 , 1 is key9 pressed ,0 is release Bit2:K10 , 1 is key10 pressed ,0 is release Bit3:K11 , 1 is key11 pressed ,0 is release Bit4:K12 , 1 is key12 pressed ,0 is release Bit5:K13 , 1 is key13 pressed ,0 is release Bit6:K14 , 1 is key14 pressed ,0 is release Bit7:K15 , 1 is key15 pressed ,0 is release

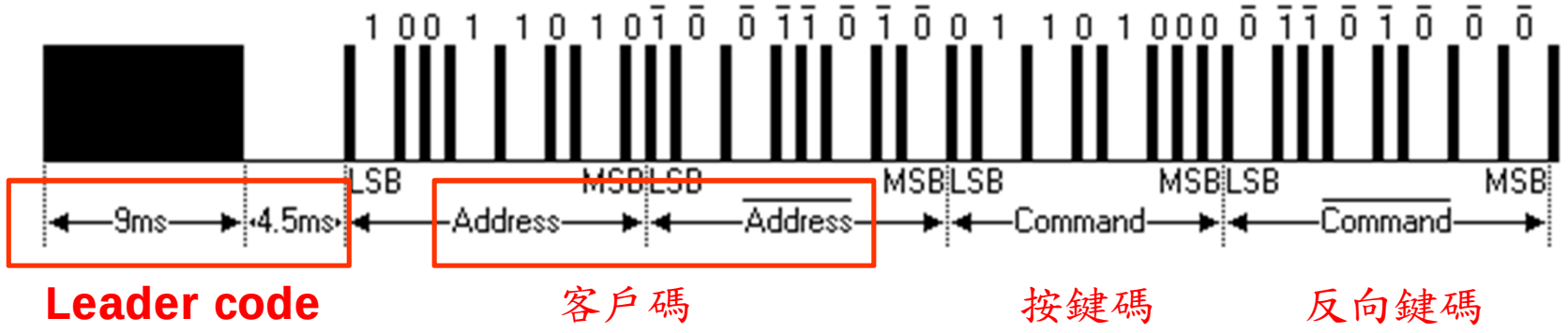
IR NEC Protocol

- Logical ”1”：由0.56ms載波和 1.69ms space 組成
- Logical ”0”：由0.56ms載波和 0.56ms space 組成



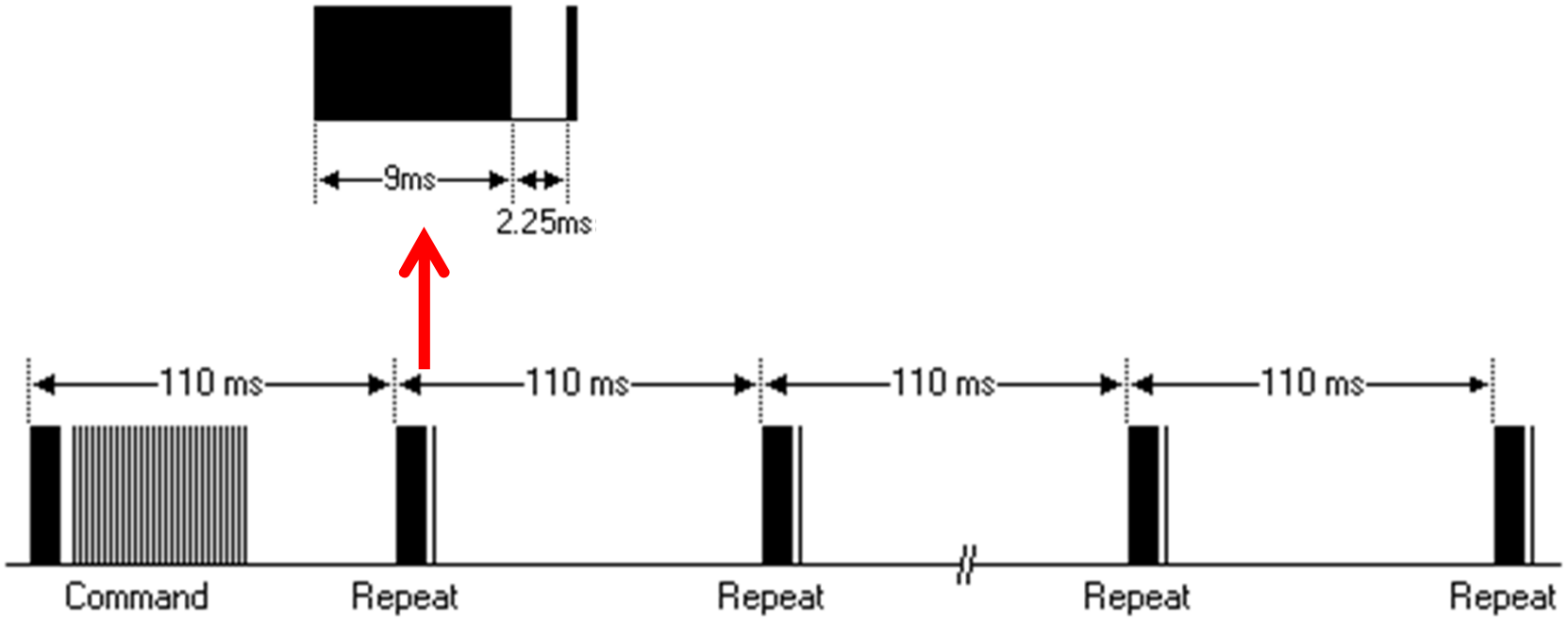
- Leader code ：由9ms載波和 4.5ms space 組成

LSB:最低位元
MSB:最高位元



IR NEC Protocol..

- Repeat code：由9ms載波和 2.25ms space 組成，每間隔 110ms傳送一次



IR TX 客戶/按鍵碼

按鍵	客戶碼1	客戶碼2	鍵碼	反向鍵碼
K0	68	B6	F0	0F
K1	68	B6	31	CE
K2	68	B6	01	FE
K3	68	B6	00	FF
K4	68	B6	10	EF
K5	68	B6	20	DF
K6	68	B6	30	CF
K7	68	B6	40	BF
K8	68	B6	50	AF
K9	68	B6	60	9F
K10	68	B6	70	8F
K11	68	B6	80	7F
K12	68	B6	90	6F
K13	68	B6	21	DE
K14	68	B6	A1	5E
K15	68	B6	E1	1E

IR Tx Register Map

SFR Addr	Description	Type	Note
0xF1	IR Tx Control Byte	R/W	Bit0:send_tx , 1:send tx data Bit1:send_repeat , 1:send repeat code Bit4:tx_complete , 1:complete
0xF2	IR TX 1 Byte	W	Tx 1 data
0xF3	IR TX 2 Byte	W	Tx 2 data
0xF4	IR TX 3 Byte	W	Tx 3 data
0xF5	IR TX 4 Byte	W	Tx 4 data

輸出文字結果

Transcript

```
#
# add wave *
# ** Warning: (vsim-WLF-5000) WLF file currently in use: vsim.wlf
#           File in use by: user  Hostname: DESKTOP-4214V85  ProcessID: 16328
#           Attempting to use alternate WLF file "./wlft1nex14".
# ** Warning: (vsim-WLF-5001) Could not open WLF file: vsim.wlf
#           Using alternate file: ./wlft1nex14
# view structure
# .main_pane.structure.interior.cs.body.struct
# view signals
# .main_pane.objects.interior.cs.body.tree
# run -all
add wave -position insertpoint sim:/lab4_tb/lab4/*
add wave -position insertpoint sim:/lab4_tb/lab4/U1/*
add wave -position insertpoint sim:/lab4_tb/lab4/U2/*
VSIM 5> restart
VSIM 6> run -all
# time=92443690 IR data = 68,b6,30,cf
# time=217446490 IR data = 68,b6,60,9f
# time=271260750 IR repeat code = 1.
# ** Note: $finish    : C:/Users/Jay/Desktop/lab4/lab4_tb.v(175)
#    Time: 388443670 ns  Iteration: 0  Instance: /lab4_tb
# 1
# Break in Module lab4_tb at C:/Users/Jay/Desktop/lab4/lab4_tb.v line 175
```

計分方式

1. 作業完成後，需將全部verilog程式、輸出波形圖截圖以及文字結果畫面截圖一起壓縮成ZIP檔案，並上傳至Moodle[繳交作業]。
2. 上傳檔案名稱：HW4_學號.ZIP
3. 助教在每周上課前驗收上傳作業，並公告驗收結果，若有問題須自行修正後重新上傳檔案，截止時間後，未完成驗收依問題情況扣分。
4. 計分標準依上傳完成順序，由100分開始遞減給分。
5. 若發現程式或輸出畫面結果有抄襲狀況，雙方此次作業分數皆為0分。

參考資料

- **DE2-115_mb_schematic.pdf**
- **DE2_115_pin_assignments.csv**
- **DW8051 IP.pdf**