Experiment 02: Case Study and Experiment for RFID Application using MiFare Smart Card Training Kit

Objectives:

Students will learn

- how to personalize the RFID contactless card to provide different types of applications to enable various services.
- how to setup the RFID contactless smart card reader and its system to provide different types of applications to enable various services.
- how to initialize and activate a suitable application using the user interface.
- how to implement a complete real life application using RFID technology.

Introduction:

In the experiment 1, students have learnt the data structures of the MiFare RFID card it. In this experiment, students will learn how to implement a complete real life application using RFID technology.

Procedure:

Firstly, students are required to personalize the five MiFare cards using **MiFare Card Personalization function**

MiFare card personalisation

1. MiFare Card Personalization function for sample application is needed to be done by clicking the MiFare Card Personalization button.

   Issue four types of cards: **one** Admin card, **one** Lecturer card, **one** Technician card and **one** Student card by using the following commands in sequence, **Erase > Read (to check "successful erase")**, **Select** card type > Enter six digit **Card Serial No**. > Enter ten digit Holder ID > Enter **Credit** Value > **Write**, and then click **Reset** >**Read** to check successful write. If all cards are completely personalized, click **Return** to **main screen**.

Note: Admin card type is for data browsing and for this type of card; it will not be allowed to choose the type of the Applications. For the Vending Machine Application, the credit amount for the card can be set and top up too. Data in sector 0 is reserved by vendor and contains fixed data and not allowed to be changed. Erase will Erase/Clear card user data from Block 4 & 5.

Figure 1: MiFare card personalization

Figure 2: Top up screen

2. Click on the MiFare button at Main screen and read the data block 4 and 5 of sector 1. Record the data in the Table 1.

Card No. 1

No.	Description	Byte	Type	Byte No.	Data	Remark
				Block 4		
1	Card Type	1	ASCII	0		
2	Card Serial No.	4	Long	1 ~ 4		
3	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14		
4	BCC for Block 4	1	Char	15		
				Block 5		
5	Current Credit	4	Long	0 ~ 3		
6	Access Valid	1	Char	4		
7	Start Date and Time	5	Char	5 ~ 9		
8	End Date and Time	5	Char	10 ~ 14		
9	BCC for Block 5	1	Char	15		

Card No. 2

No.	Description	Byte	Type	Byte No.	Data	Remark
				Block 4		
1	Card Type	1	ASCII	0		
2	Card Serial No.	4	Long	1 ~ 4		
3	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14		
4	BCC for Block 4	1	Char	15		
				Block 5		
5	Current Credit	4	Long	0 ~ 3		
6	Access Valid	1	Char	4		
7	Start Date and Time	5	Char	5 ~ 9		
8	End Date and Time	5	Char	10 ~ 14		
9	BCC for Block 5	1	Char	15		

Card No. 3

No.	Description	Byte	Type	Byte No.	Data	Remark
				Block 4		
1	Card Type	1	ASCII	0		
2	Card Serial No.	4	Long	1 ~ 4		
3	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14		
4	BCC for Block 4	1	Char	15		
				Block 5		
5	Current Credit	4	Long	0 ~ 3		
6	Access Valid	1	Char	4		
7	Start Date and Time	5	Char	5 ~ 9		
8	End Date and Time	5	Char	10 ~ 14		
9	BCC for Block 5	1	Char	15		

Card No. 4

No.	Description	Byte	Type	Byte No.	Data	Remark
				Block 4		
1	Card Type	1	ASCII	0		
2	Card Serial No.	4	Long	1 ~ 4		
3	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14		
4	BCC for Block 4	1	Char	15		
				Block 5		
5	Current Credit	4	Long	0 ~ 3		
6	Access Valid	1	Char	4		
7	Start Date and Time	5	Char	5 ~ 9		
8	End Date and Time	5	Char	10 ~ 14		
9	BCC for Block 5	1	Char	15		

Card No. 5

No.	Description	Byte	Type	Byte No.	Data	Remark
				Block 4		
1	Card Type	1	ASCII	0		
2	Card Serial No.	4	Long	1 ~ 4		
3	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14		
4	BCC for Block 4	1	Char	15		
				Block 5		
5	Current Credit	4	Long	0 ~ 3		
6	Access Valid	1	Char	4		
7	Start Date and Time	5	Char	5 ~ 9		
8	End Date and Time	5	Char	10 ~ 14		
9	BCC for Block 5	1	Char	15		

Note : **Card Type: A=Admin, L=Lecturer, S=Student, T=Technician**

3. Disconnect the cable at RS-232 port which was connected to the laptop.
4. Then, the reader module of the Training kit should be connected back to its system via RS232 cable and then the training kit is power on as in Figure 3.
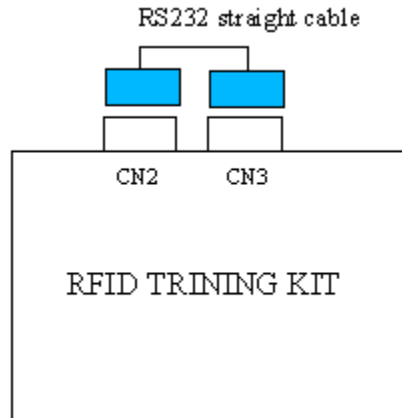
Figure 3 : Setup for Application and Case study

5. By using the five programmed cards you are required to perform the following sample applications are used as Case Study.
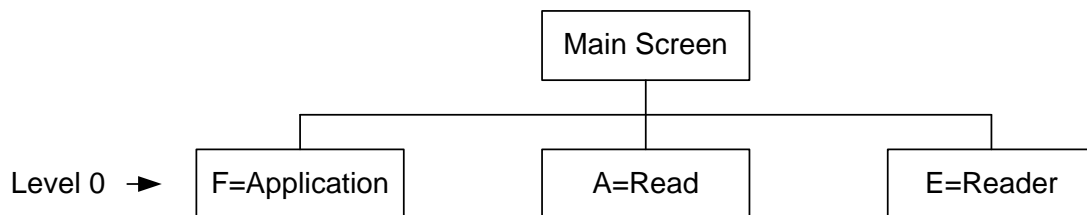
- Hardware Test and Basic Function
- Attendance Recording
- Door Access System
- Vending Machine / Cashless Payment System

Note: MiFare Standard Card with default security key (FF FF FF FF FF FF) is used for all sample applications.

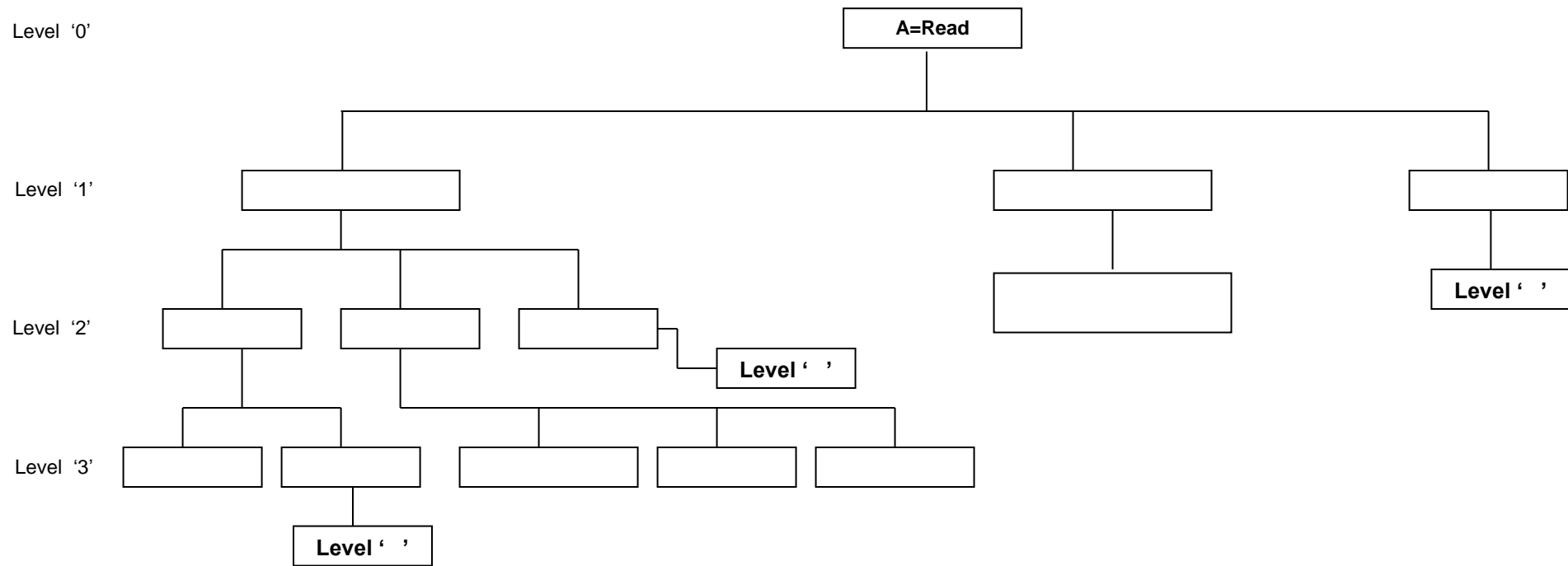The sample applications are standalone applications which **DO NOT REQUIRE** connecting to a PC.

Commands are entered from the built-in keypad and respond is shown on the LCD display and LED's. External interface can be done from the I/O connector.

From the above case study, students are required to complete the firmware flow diagrams of the RFID system. The first diagram is given as an example.

Firmware System Flow Diagram - 1

Level '0'

F=Applications

Level '1'

Level '2'

Level '0'

Level ' '

Level '3'

Level ' '

Level '0'

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Level ' '

Firmware System Flow Diagram - 2

Level '0'   **A=Read**

Level '1'

Level '2'   **Level ' '**
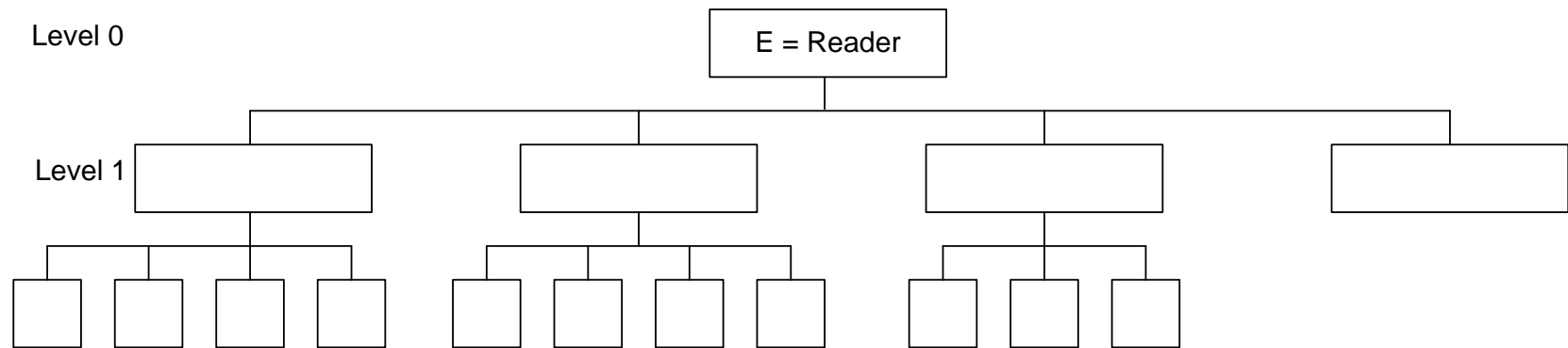
Level '3'

Level ' '

Firmware System Flow Diagram - 3

Level 0　　　　　　　　　　　　　　E = Reader

Level 1

Firmware System Flow Diagram

Appendix
MiFare Card Data Structure used for Applications

No.		Description	Byte		Type	Byte No.	Block	Sector
		Personalization -						
1		Customer's Name	16		ASCII	0 ~ 15	1	0
2		Vendor Company's Name	9		ASCII	0 ~ 8	2	0
3		Card Initialized Date	3		Char	9 ~ 11	2	0
4		Card Initialized Time	3		Char	12 ~ 14	2	0
5		Issue Flag	1		Char	15	2	0
		Read/Write Operation during Issued Card and Personalization						
5		Card Type	1		ASCII	0	4	1
6		Card Serial No.	4		Long	1 ~ 4	4	1
7		Card Identification Number (Student/Lecturer/Staff ID)	10		ASCII	5~14	4	1
8		BCC for Block 4	1		Char	15	4	1
9		Current Credit	4		Long	0 ~ 3	5	1
10		Access Valid	1		Char	4	5	1
11		Start Date and Time	5		Char	5 ~ 9	5	1
12		End Date and Time	5		Char	10 ~ 14	5	1
13		BCC for Block 5	1		Char	15	5	1

Note : Issue Flag ➔ FF = New card, 55 = already issued
Card Type: A=Admin, L=Lecturer, S=Student, T=Technician
Access Valid ➔ door lock authorize flag;   00 = Unauthorize, AA = Authorize

	Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sec 0	Blk 0	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Blk 1	C16	C15	C14	C13	C12	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1
	Blk 2	T	R	A	N	S	I	C	O	M	DD	MM	YY	hh	mm	ss	IsF
	Blk 3																
Sec 1	Blk 4	T	S4	S3	S2	S1	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	BCC
	Blk 5	CC4	CC3	CC2	CC1	AV	DD	MM	YY	hh	mm	DD	MM	YY	hh	mm	BCC
	Blk 6	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	Blk 7																

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3	Card Initialized Date	3	Char	9 ~ 11	2	0
4	Card Initialized Time	3	Char	12 ~ 14	2	0
5	Issue Flag	1	Char	15	2	0
	Read/Write Operation during Issued Card and Personalization					
5	Card Type	1	ASCII	0	4	1
6	Card Serial No.	4	Long	1 ~ 4	4	1
7	Card Identification Number (Student/Lecturer/Staff ID)	10	ASCII	5~14	4	1
8	BCC for Block 4	1	Char	15	4	1
9	Current Credit	4	Long	0 ~ 3	5	1
10	Access Valid	1	Char	4	5	1
11	Start Date and Time	5	Char	5 ~ 9	5	1
12	End Date and Time	5	Char	10 ~ 14	5	1
13	BCC for Block 5	1	Char	15	5	1

<u>**Note**</u> **:   Issue Flag □ FF = New card, 55 = already issued**
Card Type: A=Admin, L=Lecturer, S=Student, T=Technician
Access Valid □ door lock authorize flag;   00 = Unauthorize,
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