Using ADC on Firebird-V Robot

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Agenda for Discussion

1. Analog to Digital Conversion
   - Need for ADC
   - ADC of LPC2148
   - ADC Channels
2. Coding ADC
   - ADC Initilization
   - ADxCR
   - ADxGDR
   - Program

Need for ADC

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- ✓ Sharp IR Range sensors

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- ✓ Global Start command for both converters.
- ✓ Free Running or Single Conversion Mode
- ✓ Interrupt on ADC Conversion complete

ADC Channels

- Table for ADC Channels

Pin No.	Pin Name	Description
P0.13	AD1.4	ADC input for Battery Voltage Monitoring
P0.29	AD0.2	ADC input for White Line Sensor 3(Right)
P0.28	AD0.1	ADC input for White Line Sensor 2(Center)
P0.12	AD1.3	ADC input for White Line Sensor 1(Left)
P0.4	AD0.6	ADC input for Sharp IR range sensor 2
P0.6	AD1.0	ADC input for Sharp IR range sensor 3
P0.5	AD0.7	ADC input for Sharp IR range sensor 4

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15-8	CLKDIV	To produce the clock	00001110
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16	BURST	To disable Repeated conversions	0

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7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
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20	-	Reserved	

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15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	

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16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
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16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
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23-22	-	Reserved	

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7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0

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7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	

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7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000

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Bit	Symbol	Description	Bit Value
7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	

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16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
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23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0

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Bit	Symbol	Description	Bit Value
7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0
31-28	-	Reserved	

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7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0
31-28	-	Reserved	0000

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Bit	Symbol	Description	Bit Value
7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0
31-28	-	Reserved	0000

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Bit	Symbol	Description	Bit Value
7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0
31-28	-	Reserved	0000

ADxCR=0x00200E00;

ADxCR- ADCx Control Register

This register is Used to control ADC operation

Bit	Symbol	Description	Bit Value
7-0	SEL	Selects pins to be sampled and converted	00000000
15-8	CLKDIV	To produce the clock	00001110
16	BURST	To disable Repeated conversions	0
19-17	CLKS	Selects the number of clocks	000
20	-	Reserved	0
21	PDN	operational or power-down mode	1
23-22	-	Reserved	0
26-24	START	Control start of ADC conversion	000
27	EDGE	Rising or falling edge	0
31-28	-	Reserved	0000

ADxCR=0x00200E00;

ADxCR
contd...

ADxCR
contd...

ADxCR
contd...

- Bits 7-0 in ADxCR(SEL)

SEL	Description
7	1- ADx.7 is sampled and converted 0- ADx.7 is not sampled and converted
6	1- ADx.6 is sampled and converted 0- ADx.6 is not sampled and converted
5	1- ADx.5 is sampled and converted 0- ADx.5 is not sampled and converted
4	1- ADx.4 is sampled and converted 0- ADx.4 is not sampled and converted
3	1- ADx.3 is sampled and converted 0- ADx.3 is not sampled and converted
2	1- ADx.2 is sampled and converted 0- ADx.2 is not sampled and converted
1	1- ADx.1 is sampled and converted 0- ADx.1 is not sampled and converted
0	1- ADx.0 is sampled and converted 0- ADx.0 is not sampled and converted

ADxCR
contd...

ADxCR
contd...

- Bits 19-17 in ADxCR (CLKS)

Bit Value	Function
000	11clocks/ 10bits
001	10clocks/ 9bits
010	9clocks/ 8bits
011	8clocks/ 7bits
100	7clocks/ 6bits
101	6clocks/ 5bits
110	5clocks/ 4bits
111	4clocks/ 3bits

ADxCR
contd...

- Bits 19-17 in ADxCR (CLKS)

Bit Value	Function
000	11clocks/ 10bits
001	10clocks/ 9bits
010	9clocks/ 8bits
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100	7clocks/ 6bits
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ADxCR
contd...

ADxCR
contd...

- Bits 26-24 in ADxCR(START): When the BURST bit is 0, these bits control whether and when an A/D conversion is started,

Bit Value	Function
000	No start
001	Start Conversion now
010	Start conversion when the edge occurs on P0.16/MAT0.2
011	Start conversion when the edge occurs on P0.22/MAT0.0
100	Start conversion when the edge occurs on MAT0.1
101	Start conversion when the edge occurs on MAT0.3
110	Start conversion when the edge occurs on MAT1.0
111	Start conversion when the edge occurs on MAT1.1

ADxCR
contd...

- Bits 26-24 in ADxCR(START): When the BURST bit is 0, these bits control whether and when an A/D conversion is started,

Bit Value	Function
000	No start
001	Start Conversion now
010	Start conversion when the edge occurs on P0.16/MAT0.2
011	Start conversion when the edge occurs on P0.22/MAT0.0
100	Start conversion when the edge occurs on MAT0.1
101	Start conversion when the edge occurs on MAT0.3
110	Start conversion when the edge occurs on MAT1.0
111	Start conversion when the edge occurs on MAT1.1

ADxGDR - A/D Global Data Register

This register contains the ADC's DONE bit and the result of the most recent A/D conversion.

Bit	Symbol	Description
5-0	-	Reserved
15-6	RESULT	When DONE is 1, this field contains ADC converted data
23-16	-	Reserved
26-24	CHN	Channel Number
29-27	-	Reserved
30	OVERUN	1 if the results of one or more conversions were lost before the conversion that produced the result in the RESULT bits.
31	DONE	This bit is set to 1 when an A/D conversion completes.

Syntax for C-Program
ADC Initialization

Syntax for C-Program
ADC Initialization

Init_ADC_Pin

Syntax for C-Program
ADC Initialization

Init_ADC_Pin

```
void Init_ADC_Pin (void)  //Configure ADC Ports
{

PINSEL0= 0x0F003F00;  //Set pins P0.4, P0.5, P0.6, P0.12, P0.13 as ADC pins
PINSEL1= 0x05000000;  //Set pins P0.28 and P0.29 as ADC pins

}
```

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void Init_ADC_Pin (void)  //Configure ADC Ports
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PINSEL1= 0x05000000;  //Set pins P0.28 and P0.29 as ADC pins

}
```

ADC Initialization

```
void Init_ADC()  //Set Register Values for starting ADC
{

   AD0CR =
   AD1CR =
}
```

Syntax for C-Program
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Init_ADC_Pin

```
void Init_ADC_Pin (void)  //Configure ADC Ports
{

PINSEL0= 0x0F003F00;  //Set pins P0.4, P0.5, P0.6, P0.12, P0.13 as ADC pins
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}
```

ADC Initialization

```
void Init_ADC()  //Set Register Values for starting ADC
{

   AD0CR =
   AD1CR =
}
```

Syntax for C-Program
Program

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Main Program

Syntax for C-Program
Program

Main Program

```
int main(void)
{
  Init_Peripherals();
  LCD_Init();
  while(1)
  {
    LCD_Print(2,1,AD1_Conversion(3),3);   //whiteline Left
    LCD_Print(2,7,AD0_Conversion(1),3);   //whiteline Center
    LCD_Print(2,13,AD0_Conversion(2),3); //whiteline Right
  }
}
```

Syntax for C-Program
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Main Program

```
int main(void)
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  Init_Peripherals();
  LCD_Init();
  while(1)
  {
    LCD_Print(2,1,AD1_Conversion(3),3);   //whiteline Left
    LCD_Print(2,7,AD0_Conversion(1),3);   //whiteline Center
    LCD_Print(2,13,AD0_Conversion(2),3); //whiteline Right
  }
}
```

Syntax for C-Program
Program

Syntax for C-Program
Program

AD0 Conversion Function

Syntax for C-Program
Program

AD0 Conversion Function

```
unsigned char AD0_Conversion(unsigned char Ch)
{
unsigned int Temp;
if(channel!=0)
{
    AD0CR = (AD0CR & 0xFFFFFF00) | (1<<channel);
}
else
{
    AD0CR = (AD0CR & 0xFFFFFF00) | 0x01;
}
AD0CR|=(1 << 24);
while((AD0GDR & 0x80000000)==0);
Temp = AD0GDR;
Temp = (Temp>>8) & 0xFF;
return Temp;
}
```

Syntax for C-Program
Program

Syntax for C-Program
Program

AD1 Conversion Function

Syntax for C-Program
Program

AD1 Conversion Function

```
unsigned char AD1_Conversion(unsigned char Ch)
{
unsigned int Temp;
if(channel!=0)
{
    AD1CR = (AD1CR & 0xFFFFFF00) | (1<<channel);
}
else
{
    AD1CR = (AD1CR & 0xFFFFFF00) | 0x01;
}
AD1CR|=(1 << 24);
while((AD1GDR & 0x80000000)==0);
Temp = AD1GDR;
Temp = (Temp>>8) & 0xFF;
return Temp;
}
```

Thank You!

Post your queries on: http://qa.e-yantra.org/