2024

Taller de Evaluación Continua

Tecnologías de Micro procesamiento

Ingeniería Mecatrónica

Implementación de una Look-Up Table (LUT) en el ATmega328P con un DAC R-2R

Para generar la señal especificada en el cuadro adjunto, cada equipo deberá implementar un código en ensamblador (assembler) en el microcontrolador ATmega328P. Este código permitirá la salida de la señal designada a través de un convertidor digital a analógico (DAC) del tipo R-2R. La señal generada deberá ser visualizada y analizada en un osciloscopio, permitiendo a los estudiantes observar y evaluar su correcta implementación.

Descripción del proceso:

1. **Look-Up Table (LUT)**: Se utilizará una tabla de valores precalculados que corresponde a la señal a generar. Estos valores serán escritos secuencialmente en los pines de salida conectados al DAC R-2R para generar la señal analógica.
2. **Conversión Digital a Analógica (DAC R-2R)**: La configuración R-2R convierte la señal digital generada por el microcontrolador en una señal analógica proporcional, la cual será enviada al osciloscopio para su observación.
3. **Osciloscopio**: La salida analógica será visualizada en el osciloscopio, donde se podrá verificar que la señal corresponde a la forma de onda designada.

Requisitos:

- Cada equipo deberá:
  - Implementar la LUT correspondiente a la señal especificada.
  - Escribir un programa en ensamblador para el ATmega328P que envíe los valores de la LUT al DAC R-2R.
  - Asegurarse de que la señal analógica generada sea visible en el osciloscopio.
  - Ajustar la frecuencia de salida mediante la manipulación del temporizador del ATmega328P.

Objetivo: El objetivo de este ejercicio es aprender cómo implementar señales analógicas mediante un convertidor R-2R, utilizando una LUT para generar formas de onda específicas desde un microcontrolador de 8 bits.

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Grupo 1	Grupo 2	Grupo 3	Grupo 4	Grupo 5	Grupo 6
Señal 4	**Señal 6**	**Señal 6**	**Señal 2**	**Señal 3**	**Señal 1**
Luis Nuñez	Ignacio Da Silveira	Facundo Cabrera	Neo Barrios	Enzo Acosta	Rubén Romero
Belén Boado	Thomas Ruiz	Guido Andreoli			Lucas De León
Adrián Terzaghi	Braian Arias				Romina Fredes
Grupo 7	**Grupo 8**	**Grupo 9**			
Señal 1	**Señal 6**	**Señal 5**			
Jeronimo Fernandez	Luis Nunez Da Rosa	Angelo Ferrari			
Andrés González	Rodrigo Karlen				
Priscila Rossi	Francisco Mayol				

SEÑALES

Señal 1:

0x80,0x83,0x86,0x89,0x8c,0x8f,0x92,0x95,0x98,0x9c,0x9f,0xa2,0xa5,0xa8,0xab,0xae,

0xb0,0xb3,0xb6,0xb9,0xbc,0xbf,0xc1,0xc4,0xc7,0xc9,0xcc,0xce,0xd1,0xd3,0xd5,0xd8,

0xda,0xdc,0xde,0xe0,0xe2,0xe4,0xe6,0xe8,0xea,0xec,0xed,0xef,0xf0,0xf2,0xf3,0xf5,

0xf6,0xf7,0xf8,0xf9,0xfa,0xfb,0xfc,0xfc,0xfd,0xfe,0xfe,0xff,0xff,0xff,0xff,0xff,

0xff,0xff,0xff,0xff,0xff,0xff,0xfe,0xfe,0xfd,0xfc,0xfc,0xfb,0xfa,0xf9,0xf8,0xf7,

0xf6,0xf5,0xf3,0xf2,0xf0,0xef,0xed,0xec,0xea,0xe8,0xe6,0xe4,0xe2,0xe0,0xde,0xdc,

0xda,0xd8,0xd5,0xd3,0xd1,0xce,0xcc,0xc9,0xc7,0xc4,0xc1,0xbf,0xbc,0xb9,0xb6,0xb3,

0xb0,0xae,0xab,0xa8,0xa5,0xa2,0x9f,0x9c,0x98,0x95,0x92,0x8f,0x8c,0x89,0x86,0x83,

0x80,0x7c,0x79,0x76,0x73,0x70,0x6d,0x6a,0x67,0x63,0x60,0x5d,0x5a,0x57,0x54,0x51,

0x4f,0x4c,0x49,0x46,0x43,0x40,0x3e,0x3b,0x38,0x36,0x33,0x31,0x2e,0x2c,0x2a,0x27,

0x25,0x23,0x21,0x1f,0x1d,0x1b,0x19,0x17,0x15,0x13,0x12,0x10,0x0f,0x0d,0x0c,0x0a,

0x09,0x08,0x07,0x06,0x05,0x04,0x03,0x03,0x02,0x01,0x01,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x01,0x01,0x02,0x03,0x03,0x04,0x05,0x06,0x07,0x08,

0x09,0x0a,0x0c,0x0d,0x0f,0x10,0x12,0x13,0x15,0x17,0x19,0x1b,0x1d,0x1f,0x21,0x23,

0x25,0x27,0x2a,0x2c,0x2e,0x31,0x33,0x36,0x38,0x3b,0x3e,0x40,0x43,0x46,0x49,0x4c,

0x4f,0x51,0x54,0x57,0x5a,0x5d,0x60,0x63,0x67,0x6a,0x6d,0x70,0x73,0x76,0x79,0x7c

Señal 2:

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,

0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,

0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,

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0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,
0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff,0xff

Señal 3

0x00,0x01,0x02,0x03,0x04,0x05,0x06,0x07,0x08,0x09,0x0a,0x0b,0x0c,0x0d,0x0e,0x0f,
0x10,0x11,0x12,0x13,0x14,0x15,0x16,0x17,0x18,0x19,0x1a,0x1b,0x1c,0x1d,0x1e,0x1f,
0x20,0x21,0x22,0x23,0x24,0x25,0x26,0x27,0x28,0x29,0x2a,0x2b,0x2c,0x2d,0x2e,0x2f,
0x30,0x31,0x32,0x33,0x34,0x35,0x36,0x37,0x38,0x39,0x3a,0x3b,0x3c,0x3d,0x3e,0x3f,
0x40,0x41,0x42,0x43,0x44,0x45,0x46,0x47,0x48,0x49,0x4a,0x4b,0x4c,0x4d,0x4e,0x4f,
0x50,0x51,0x52,0x53,0x54,0x55,0x56,0x57,0x58,0x59,0x5a,0x5b,0x5c,0x5d,0x5e,0x5f,
0x60,0x61,0x62,0x63,0x64,0x65,0x66,0x67,0x68,0x69,0x6a,0x6b,0x6c,0x6d,0x6e,0x6f,
0x70,0x71,0x72,0x73,0x74,0x75,0x76,0x77,0x78,0x79,0x7a,0x7b,0x7c,0x7d,0x7e,0x7f,
0x80,0x81,0x82,0x83,0x84,0x85,0x86,0x87,0x88,0x89,0x8a,0x8b,0x8c,0x8d,0x8e,0x8f,
0x90,0x91,0x92,0x93,0x94,0x95,0x96,0x97,0x98,0x99,0x9a,0x9b,0x9c,0x9d,0x9e,0x9f,
0xa0,0xa1,0xa2,0xa3,0xa4,0xa5,0xa6,0xa7,0xa8,0xa9,0xaa,0xab,0xac,0xad,0xae,0xaf,
0xb0,0xb1,0xb2,0xb3,0xb4,0xb5,0xb6,0xb7,0xb8,0xb9,0xba,0xbb,0xbc,0xbd,0xbe,0xbf,
0xc0,0xc1,0xc2,0xc3,0xc4,0xc5,0xc6,0xc7,0xc8,0xc9,0xca,0xcb,0xcc,0xcd,0xce,0xcf,
0xd0,0xd1,0xd2,0xd3,0xd4,0xd5,0xd6,0xd7,0xd8,0xd9,0xda,0xdb,0xdc,0xdd,0xde,0xdf,
0xe0,0xe1,0xe2,0xe3,0xe4,0xe5,0xe6,0xe7,0xe8,0xe9,0xea,0xeb,0xec,0xed,0xee,0xef,
0xf0,0xf1,0xf2,0xf3,0xf4,0xf5,0xf6,0xf7,0xf8,0xf9,0xfa,0xfb,0xfc,0xfd,0xfe,0xff

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Señal 4:

0xff,0xfe,0xfd,0xfc,0xfb,0xfa,0xf9,0xf8,0xf7,0xf6,0xf5,0xf4,0xf3,0xf2,0xf1,0xf0,

0xef,0xee,0xed,0xec,0xeb,0xea,0xe9,0xe8,0xe7,0xe6,0xe5,0xe4,0xe3,0xe2,0xe1,0xe0,

0xdf,0xde,0xdd,0xdc,0xdb,0xda,0xd9,0xd8,0xd7,0xd6,0xd5,0xd4,0xd3,0xd2,0xd1,0xd0,

0xcf,0xce,0xcd,0xcc,0xcb,0xca,0xc9,0xc8,0xc7,0xc6,0xc5,0xc4,0xc3,0xc2,0xc1,0xc0,

0xbf,0xbe,0xbd,0xbc,0xbb,0xba,0xb9,0xb8,0xb7,0xb6,0xb5,0xb4,0xb3,0xb2,0xb1,0xb0,

0xaf,0xae,0xad,0xac,0xab,0xaa,0xa9,0xa8,0xa7,0xa6,0xa5,0xa4,0xa3,0xa2,0xa1,0xa0,

0x9f,0x9e,0x9d,0x9c,0x9b,0x9a,0x99,0x98,0x97,0x96,0x95,0x94,0x93,0x92,0x91,0x90,

0x8f,0x8e,0x8d,0x8c,0x8b,0x8a,0x89,0x88,0x87,0x86,0x85,0x84,0x83,0x82,0x81,0x80,

0x7f,0x7e,0x7d,0x7c,0x7b,0x7a,0x79,0x78,0x77,0x76,0x75,0x74,0x73,0x72,0x71,0x70,

0x6f,0x6e,0x6d,0x6c,0x6b,0x6a,0x69,0x68,0x67,0x66,0x65,0x64,0x63,0x62,0x61,0x60,

0x5f,0x5e,0x5d,0x5c,0x5b,0x5a,0x59,0x58,0x57,0x56,0x55,0x54,0x53,0x52,0x51,0x50,

0x4f,0x4e,0x4d,0x4c,0x4b,0x4a,0x49,0x48,0x47,0x46,0x45,0x44,0x43,0x42,0x41,0x40,

0x3f,0x3e,0x3d,0x3c,0x3b,0x3a,0x39,0x38,0x37,0x36,0x35,0x34,0x33,0x32,0x31,0x30,

0x2f,0x2e,0x2d,0x2c,0x2b,0x2a,0x29,0x28,0x27,0x26,0x25,0x24,0x23,0x22,0x21,0x20,

0x1f,0x1e,0x1d,0x1c,0x1b,0x1a,0x19,0x18,0x17,0x16,0x15,0x14,0x13,0x12,0x11,0x10,

0x0f,0x0e,0x0d,0x0c,0x0b,0x0a,0x09,0x08,0x07,0x06,0x05,0x04,0x03,0x02,0x01,0x00,

Señal 5

0x00,0x02,0x04,0x06,0x08,0x0a,0x0c,0x0e,0x10,0x12,0x14,0x16,0x18,0x1a,0x1c,0x1e,

0x20,0x22,0x24,0x26,0x28,0x2a,0x2c,0x2e,0x30,0x32,0x34,0x36,0x38,0x3a,0x3c,0x3e,
0x40,0x42,0x44,0x46,0x48,0x4a,0x4c,0x4e,0x50,0x52,0x54,0x56,0x58,0x5a,0x5c,0x5e,
0x60,0x62,0x64,0x66,0x68,0x6a,0x6c,0x6e,0x70,0x72,0x74,0x76,0x78,0x7a,0x7c,0x7e,
0x80,0x82,0x84,0x86,0x88,0x8a,0x8c,0x8e,0x90,0x92,0x94,0x96,0x98,0x9a,0x9c,0x9e,
0xa0,0xa2,0xa4,0xa6,0xa8,0xaa,0xac,0xae,0xb0,0xb2,0xb4,0xb6,0xb8,0xba,0xbc,0xbe,
0xc0,0xc2,0xc4,0xc6,0xc8,0xca,0xcc,0xce,0xd0,0xd2,0xd4,0xd6,0xd8,0xda,0xdc,0xde,
0xe0,0xe2,0xe4,0xe6,0xe8,0xea,0xec,0xee,0xf0,0xf2,0xf4,0xf6,0xf8,0xfa,0xfc,0xfe,
0xff,0xfd,0xfb,0xf9,0xf7,0xf5,0xf3,0xf1,0xef,0xef,0xeb,0xe9,0xe7,0xe5,0xe3,0xe1,
0xdf,0xdd,0xdb,0xd9,0xd7,0xd5,0xd3,0xd1,0xcf,0xcf,0xcb,0xc9,0xc7,0xc5,0xc3,0xc1,
0xbf,0xbd,0xbb,0xb9,0xb7,0xb5,0xb3,0xb1,0xaf,0xaf,0xab,0xa9,0xa7,0xa5,0xa3,0xa1,
0x9f,0x9d,0x9b,0x99,0x97,0x95,0x93,0x91,0x8f,0x8f,0x8b,0x89,0x87,0x85,0x83,0x81,
0x7f,0x7d,0x7b,0x79,0x77,0x75,0x73,0x71,0x6f,0x6f,0x6b,0x69,0x67,0x65,0x63,0x61,
0x5f,0x5d,0x5b,0x59,0x57,0x55,0x53,0x51,0x4f,0x4f,0x4b,0x49,0x47,0x45,0x43,0x41,
0x3f,0x3d,0x3b,0x39,0x37,0x35,0x33,0x31,0x2f,0x2f,0x2b,0x29,0x27,0x25,0x23,0x21,
0x1f,0x1d,0x1b,0x19,0x17,0x15,0x13,0x11,0x0f,0x0f,0x0b,0x09,0x07,0x05,0x03,0x01

Señal 6

73,74,75,75,74,73,73,73,73,72,71,69,68,67,67,67,
68,68,67,65,62,61,59,57,56,55,55,54,54,54,55,55,
55,55,55,55,54,53,51,50,49,49,52,61,77,101,132,
169,207,238,255,254,234,198,154,109,68,37,17,5,
0,1,6,13,20,28,36,45,52,57,61,64,65,66,67,68,68,

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69,70,71,71,71,71,71,71,71,71,72,72,72,73,73,74,

75,75,76,77,78,79,80,81,82,83,84,86,88,91,93,96,

98,100,102,104,107,109,112,115,118,121,123,125,

126,127,127,127,127,127,126,125,124,121,119,116,

113,109,105,102,98,95,92,89,87,84,81,79,77,76,75,

74,73,72,70,69,68,67,67,67,68,68,68,69,69,69,69,

69,69,69,70,71,72,73,73,74,74,75,75,75,75,75,75,

74,74,73,73,73,73,72,72,72,71,71,71,71,71,71,71,

70,70,70,69,69,69,69,69,70,70,70,69,68,68,67,67,

67,67,66,66,66,65,65,65,65,65,65,65,65,64,64,63,

63,64,64,65,65,65,65,65,65,65,64,64,64,64,64,64,

64,64,65,65,65,66,67,68,69,71,72,73