BAJO NIVEL:

|  |
| --- |
| unsigned long T0,TF;//definimos las variables del tiempo al principio y al final como long sin signos |
|  | int arriba\_Act=0;//Variable para el pulsador |
|  | int contador=0;//Variable para el contador de pulsos |
|  |  |
|  | void setup() { |
|  |  |
|  | DDRD = B11111000; //Puerto D (pines digitales del 0 al 7), |
|  | DDRB = B11111; //Puerto B (pines digitales del 8 al 13), |
|  | DDRC = B00000; //Puerto C (pines analógicos del 0 al 5), |
|  |  |
|  | Serial.begin(9600); //velocidad de comunicación serial de 9600 bits por segundo |
|  | } |
|  |  |
|  | void loop() { |
|  | T0=micros(); //igualamos la variable long sin signo a la funcion "micros" que es del mismo tipo que "milis" |
|  | byte valor = PINC; |
|  |  |
|  | if ((valor)&&(arriba\_Act==0)){ //Verifica la posición del pulsador |
|  | contador++; //le sumo 1 al la variable pulsador en caso que se cumpla |
|  |  |
|  | if(contador>=3){ //Limita el valor del contador para que vuelva a la primera letra en este caso |
|  | contador=0; |
|  | } |
|  | } |
|  |  |
|  | switch(contador){ //hacemos un switch para los diferente casos de letras |
|  | case 0: |
|  | //J |
|  | PORTD = B10011000; //prende el led fila 1,4,5 de la columna 1 |
|  | PORTB = B10000; |
|  | delay(10); |
|  | PORTD = B10001000;//prende el led fila 1,5 de la columna 2 |
|  | PORTB = B01000; |
|  | delay(10); |
|  | PORTD = B11111000;//prende todas las filas de la columna 3 |
|  | PORTB = B00100; |
|  | delay(10); |
|  | PORTD = B10000000;//prende el led fila 1 de la columna 4 |
|  | PORTB = B00010; |
|  | delay(10); |
|  | PORTD = B10000000;//prende el led fila 1 de la columna 5 |
|  | PORTB = B00001; |
|  | delay(10); |
|  | break; |
|  |  |
|  | case 1: |
|  | //B |
|  | PORTD = B11111000;//prende todas las filas de la columna 1 |
|  | PORTB = B10000; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 2 |
|  | PORTB = B01000; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 3 |
|  | PORTB = B00100; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 4 |
|  | PORTB = B00010; |
|  | delay(10); |
|  | PORTD = B01010000;//prende el led fila 2,4 de la columna 5 |
|  | PORTB = B00001; |
|  | delay(10); |
|  | break; |
|  |  |
|  | case 2: |
|  | //S |
|  | PORTD = B11101000;//prende el led fila 1,2,3,5 de la columna 1 |
|  | PORTB = B10000; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 2 |
|  | PORTB = B01000; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 3 |
|  | PORTB = B00100; |
|  | delay(10); |
|  | PORTD = B10101000;//prende el led fila 1,3,5 de la columna 4 |
|  | PORTB = B00010; |
|  | delay(10); |
|  | PORTD = B10111000;//prende el led fila 1,3,4,5 de la columna 5 |
|  | PORTB = B00001; |
|  | delay(10); |
|  | break; |
|  |  |
|  | } |
|  | TF = micros()-T0; //Calculo el tiempo que pasó desde que se tomó la muestra T0 hasta ahora |
|  | Serial.print("El tiempo total en microsegundos usando programacion en bajo nivel es: "); |
|  | Serial.println(TF); //alrededor de 76 us para Arduino Uno |
|  | } |
|  |  |
|  | /\*la conclusion que hemos llegado es que al hacer el programa con programacion en bajo nivel el |
|  | tiempo de ejecucion de un solo bucle loop se realiza mas rapido pero hay que tener en cuenta el |
|  | codigo tiene que ser el mismo ya que sino no se aprecia dicho tiempo\*/ |
|  |  |
|  | /\*link tinkercad: https://www.tinkercad.com/things/5IjhafjI5ZS-copy-of-matriz-en-bajo-nivel/editel?sharecode=G4FwltOUce3gM6F5hECBYhBHMLQJsu7nOWiPIgWKB5E \*/ |

PROGRAMACION COMUN:

|  |
| --- |
| #define arriba A5 //definimos arriba a la entrada del pulsador |
|  | int arriba\_Act=0; //Variable para el pulsador |
|  | int contador=0; //Variable para el contador de pulsos |
|  | unsigned long T0,TF;//definimos las variables del tiempo al principio y al final como long sin signos |
|  |  |
|  | void setup() { |
|  |  |
|  | //Definición de salidas |
|  |  |
|  | for(int i=3;i<13;i++) |
|  | { |
|  | pinMode(i,OUTPUT); |
|  | } |
|  | pinMode(arriba, INPUT); |
|  |  |
|  | Serial.begin(9600);//velocidad de comunicación serial de 9600 bits por segundo |
|  | } |
|  |  |
|  | void loop() { |
|  | T0=micros();//igualamos la variable long sin signo a la funcion "micros" que es del mismo tipo que "milis" |
|  |  |
|  | if ((digitalRead(arriba))&&(arriba\_Act==0)){ //Verifica la posición del pulsador |
|  | contador++; //le sumo 1 al la variable pulsador en caso que se cumpla |
|  |  |
|  | if(contador>=3){ //Limita el valor del contador para que vuelva a la primera letra en este caso |
|  | contador=0; |
|  | } |
|  | } |
|  | switch(contador){ //hacemos un switch para los diferente casos de letras |
|  |  |
|  | //J |
|  | case 0: |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 1 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,LOW); |
|  | digitalWrite(4,HIGH);//PRENDER LED 4 DE LA COLUMNA 1 |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 1 |
|  | digitalWrite(12,HIGH);//COLUMNA 1 |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 2 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,LOW); |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 2 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,HIGH);//COLUMNA 2 |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 3 |
|  | digitalWrite(6,HIGH);//PRENDER LED 2 DE LA COLUMNA 3 |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 3 |
|  | digitalWrite(4,HIGH);//PRENDER LED 4 DE LA COLUMNA 3 |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 3 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,HIGH);//COLUMNA 3 |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 4 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,LOW); |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,LOW); |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,HIGH);//COLUMNA 4 |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 5 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,LOW); |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,LOW); |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,HIGH);//COLUMNA 5 |
|  | delay(10); |
|  |  |
|  | break; |
|  |  |
|  | //B |
|  | case 1: |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 1 |
|  | digitalWrite(6,HIGH);//PRENDER LED 2 DE LA COLUMNA 1 |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 1 |
|  | digitalWrite(4,HIGH);//PRENDER LED 4 DE LA COLUMNA 1 |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 1 |
|  | digitalWrite(12,HIGH);//COLUMNA 1 |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 2 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 2 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 2 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,HIGH);//COLUMNA 2 |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 3 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 3 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 3 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,HIGH);//COLUMNA 3 |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 4 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 4 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 4 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,HIGH);//COLUMNA 4 |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,LOW); |
|  | digitalWrite(6,HIGH);//PRENDER LED 2 DE LA COLUMNA 5 |
|  | digitalWrite(5,LOW); |
|  | digitalWrite(4,HIGH);//PRENDER LED 4 DE LA COLUMNA 5 |
|  | digitalWrite(3,LOW); |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,HIGH);//COLUMNA 5 |
|  | delay(10); |
|  |  |
|  | break; |
|  |  |
|  | //S |
|  | case 2: |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 1 |
|  | digitalWrite(6,HIGH);//PRENDER LED 2 DE LA COLUMNA 1 |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 1 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 1 |
|  | digitalWrite(12,HIGH);//COLUMNA 1 |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 2 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 2 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 2 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,HIGH);//COLUMNA 2 |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 3 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 3 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 3 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,HIGH);//COLUMNA 3 |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 4 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 4 |
|  | digitalWrite(4,LOW); |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 4 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,HIGH);//COLUMNA 4 |
|  | digitalWrite(8,LOW); |
|  | delay(10); |
|  |  |
|  | digitalWrite(7,HIGH);//PRENDER LED 1 DE LA COLUMNA 5 |
|  | digitalWrite(6,LOW); |
|  | digitalWrite(5,HIGH);//PRENDER LED 3 DE LA COLUMNA 5 |
|  | digitalWrite(4,HIGH);//PRENDER LED 4 DE LA COLUMNA 5 |
|  | digitalWrite(3,HIGH);//PRENDER LED 5 DE LA COLUMNA 5 |
|  | digitalWrite(12,LOW); |
|  | digitalWrite(11,LOW); |
|  | digitalWrite(10,LOW); |
|  | digitalWrite(9,LOW); |
|  | digitalWrite(8,HIGH);//COLUMNA 5 |
|  | delay(10); |
|  |  |
|  | break; |
|  | } |
|  | TF = micros()-T0; //Calculo el tiempo que pasó desde que se tomó la muestra T0 hasta ahora |
|  | Serial.print("El tiempo total en microsegundos usando las librerias de arduino es: "); |
|  | Serial.println(TF); //alrededor de 76 us para Arduino Uno |
|  | } |
|  | /\*link tinkercad: https://www.tinkercad.com/things/iOaOwLHqFr3-copy-of-copy-of-copy-of-copy-of-led-matrix-5x5/editel?sharecode=pKpsiSy7L-jYDHmCSe1-0cn12AOR8PSx-ipfLwR4up4 \*/ |