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| /\*  \* Lab\_Elective\_1.c  \*  \* Created: 10/22/2018 8:19:15 PM  \* Author : David  \*/  #define F\_CPU 1000000UL // 1 MHz    #include <avr/io.h> #include <avr/interrupt.h> #include <stdbool.h> #include <util/delay.h>          #include <avr/io.h> #include <avr/interrupt.h>  /\* USED FOR CREATING A SYNCRONOUS STATE MACHINE\*/ volatile unsigned char TimerFlag = 0; // TimerISR() sets this to 1. C programmer should clear to 0.  unsigned int t; unsigned int t\_2;   /\* variables used for left-right ticking\*/ bool shift\_left; bool shift\_right; bool stay;  bool ms100tick; bool ms250tick; bool ms500tick; bool ms1000tick;  /\* variables used for up-down ticking\*/ bool shift\_up; bool shift\_down; bool stay\_2;  bool ms100tick\_2; bool ms250tick\_2; bool ms500tick\_2; bool ms1000tick\_2;   // Internal variables for mapping AVR's ISR to our cleaner TimerISR model. unsigned long \_avr\_timer\_M = 1; // Start count from here, down to 0. Default 1 ms. unsigned long \_avr\_timer\_cntcurr = 0; // Current internal count of 1ms ticks  void **TimerOn**() {  // AVR timer/counter controller register TCCR1  TCCR1B = 0x0B;// bit3 = 0: CTC mode (clear timer on compare)  // bit2bit1bit0=011: pre-scaler /64  // 00001011: 0x0B  // SO, 8 MHz clock or 8,000,000 /64 = 125,000 ticks/s  // Thus, TCNT1 register will count at 125,000 ticks/s   // AVR output compare register OCR1A.  OCR1A = 125; // Timer interrupt will be generated when TCNT1==OCR1A   // We want a 1 ms tick. 0.001 s \* 125,000 ticks/s = 125  // So when TCNT1 register equals 125,  // 1 ms has passed. Thus, we compare to 125.  // AVR timer interrupt mask register  TIMSK1 = 0x02; // bit1: OCIE1A -- enables compare match interrupt   //Initialize avr counter  TCNT1=0;   \_avr\_timer\_cntcurr = \_avr\_timer\_M;  // TimerISR will be called every \_avr\_timer\_cntcurr milliseconds   //Enable global interrupts  SREG |= 0x80; // 0x80: 1000000 }  void **TimerOff**() {  TCCR1B = 0x00; // bit3bit1bit0=000: timer off }  void **TimerISR**() {  TimerFlag = 1; }  // In our approach, the C programmer does not touch this ISR, but rather TimerISR() ISR(TIMER1\_COMPA\_vect) {  // CPU automatically calls when TCNT1 == OCR1 (every 1 ms per TimerOn settings)  \_avr\_timer\_cntcurr--; // Count down to 0 rather than up to TOP  if (\_avr\_timer\_cntcurr == 0) { // results in a more efficient compare  TimerISR(); // Call the ISR that the user uses  \_avr\_timer\_cntcurr = \_avr\_timer\_M;  } }  // Set TimerISR() to tick every M ms void **TimerSet**(unsigned long M) {  \_avr\_timer\_M = M/10;  \_avr\_timer\_cntcurr = \_avr\_timer\_M; }       unsigned short input; unsigned char lit\_led = 0x01; // illuminated LED // ADEN: Enables analog-to-digital conversion // ADSC: Starts analog-to-digital conversion // ADATE: Enables auto-triggering, allowing for constant // analog to digital conversions. // Note: Do not need to set the DDRA to enable the Analog to Digital circuitry void **A2D\_init**() {  ADCSRA |= (1 << ADEN) | (1 << ADSC) | (1 << ADATE); } unsigned short **adc\_read**() {  // start single conversion  // write '1' to ADIF  ADCSRA |= (1<<ADIF);    // wait for conversion to complete  // ADIF becomes '0' again  while( ADCSRA & (1<<ADIF));  return (ADC); }  // Pins on PORTA are used as input for A2D conversion // The default channel is 0 (PA0) // The value of pinNum determines the pin on PORTA // used for A2D conversion // Valid values range between 0 and 7, where the value // represents the desired pin for A2D conversion void **Set\_A2D\_Pin**(unsigned char pinNum) {  ADMUX = (pinNum <= 0x07) ? pinNum : ADMUX;  // Allow channel to stabilize  static unsigned char i = 0;  for ( i=0; i<15; i++ )  {  asm("nop");  } }  enum LED\_States {Wait, Left, Right} LED\_State; void **LED\_Tick**()  {  // Transitions  switch (LED\_State)  {  case Wait:  if( input > 450 && input < 550 ) {  LED\_State = Wait;  }  else if( input < 450 ) {  LED\_State = Right;  }  else if( input > 550 ) {  LED\_State = Left;  }  break;  case Left:  if( input < 450 ) {  LED\_State = Right;  }  else if( input > 550 ) {  LED\_State = Left;  }  else {  LED\_State = Wait;  }  break;  case Right:  if( input < 450 ) {  LED\_State = Right;  }  else if( input > 550 ) {  LED\_State = Left;  }  else {  LED\_State = Wait;  }  break;  default:  LED\_State= Wait;  break;  }    // Actions  switch (LED\_State)  {  case Wait:  break;  case Left:  if( lit\_led == 0x80 ) {  lit\_led = 0x01;  }  else {  lit\_led = lit\_led << 1;  }  break;  case Right:  if( lit\_led == 0x01 ) {  lit\_led = 0x80;  }  else {  lit\_led = lit\_led >> 1;  }  break;  }  }      void **displayCol**(){   if(ADC <= 0x80){  // 128, 1  PORTC = 0x80;  } else if(ADC > 0x80 && ADC <= 0x100){  // 256, 2   PORTC = 0x40;  } else if(ADC > 0x100 && ADC <= 0x180){  // 384, 4  PORTC = 0x20;  } else if(ADC > 0x180 && ADC <= 0x200 ){  // 512, 8  PORTC = 0x10;  } else if(ADC > 0x200 && ADC <= 0x280){  // 640, 16  PORTC = 0x08;  } else if(ADC > 0x280 && ADC <= 0x300){  // 768, 32  PORTC = 0x04;  } else if (ADC > 0x300 && ADC <= 0x380){  // 896, 64  PORTC = 0x02;  } else if(ADC > 0x380 && ADC <= 1024){  // 1024, 128  PORTC = 0x01;  }    }      void **selectRow**(){    if(ADC <= 0x80){  // 128, 1  //PORTD = 0xFE;  PORTD = 0x7F;  } else if(ADC > 0x80 && ADC <= 0x100){  // 256, 2  //PORTD = 0xFD;  PORTD = 0xBF;  } else if(ADC > 0x100 && ADC <= 0x180){  // 384, 4  //PORTD = 0xFB;  PORTD = 0xDF;  } else if(ADC > 0x180 && ADC <= 0x200 ){  // 512, 8  //PORTD = 0xF7;  PORTD = 0xEF;  } else if(ADC > 0x200 && ADC <= 0x280){  // 640, 16  //PORTD = 0xEF;  PORTD = 0xF7;  } else if(ADC > 0x280 && ADC <= 0x300){  // 768, 32  //PORTD = 0xDF;  PORTD = 0xFB;  } else if (ADC > 0x300 && ADC <= 0x380){  // 896, 64  //PORTD = 0xBF;  PORTD = 0xFD;  } else if(ADC > 0x380 && ADC <= 1024){  // 1024, 128  //PORTD = 0x6F;  PORTD = 0xFE;  }    }    void **vertSelect**(){    if(ADC >=0 && ADC < 128){    // tick the appropiate state machine  ms100tick\_2 = true;  ms250tick\_2 = false;  ms500tick\_2 = false;  ms1000tick\_2 = false;    // shift in the appropiate direction  shift\_down = true;  shift\_up = false;  stay\_2 = false;    } else if(ADC >= 128 && ADC < 256){    // tick the appropiate state machine  ms100tick\_2 = false;  ms250tick\_2 = true;  ms500tick\_2 = false;  ms1000tick\_2 = false;      // go in the correct direction  shift\_down = true;  shift\_up = false;  stay\_2 = false;  } else if(ADC >= 256 && ADC < 384 ){  // tick the correct sm  ms100tick\_2 = false;  ms250tick\_2 = false;  ms500tick\_2 = true;  ms1000tick\_2 = false;    // go in the correct direction  shift\_down = true;  shift\_up = false;  stay\_2 = false;  } else if(ADC >= 384 && ADC < 448){  // tick the correct sm  ms100tick\_2 = false;  ms250tick\_2 = false;  ms500tick\_2 = false;  ms1000tick\_2 = true;    // go in the correct direction  shift\_down = true;  shift\_up = false;  stay\_2 = false;  } else if( ADC >= 448 && ADC < 576){    // don't tick any sm since no movement  ms100tick\_2 = false;  ms250tick\_2 = false;  ms500tick\_2 = false;  ms1000tick\_2 = false;    // go in the correct direction  shift\_down = false;  shift\_up = false;  stay\_2 = true;  } else if( ADC >= 576 && ADC < 640){  // tick the correct sm  ms100tick\_2 = false;  ms250tick\_2 = false;  ms500tick\_2 = false;  ms1000tick\_2 = true;    // go in the right direction  shift\_up = true;  shift\_down = false;  stay\_2 = false;  } else if (ADC >= 640 && ADC < 768){  //tick the correct sm  ms100tick\_2 = false;  ms250tick\_2 = false;  ms500tick\_2 = true;  ms1000tick\_2 = false;    // go in the right direction  shift\_up = true;  shift\_down = false;  stay\_2 = false;  } else if (ADC >= 768 && ADC <896){  // tick the correct sm  ms100tick\_2 = false;  ms250tick\_2 = true;  ms500tick\_2 = false;  ms1000tick\_2 = false;    // go in the right direction  shift\_up = true;  shift\_down = false;  stay\_2 = false;  } else if(ADC >= 896 && ADC <1024){  ms100tick\_2 = true;  ms250tick\_2 = false;  ms500tick\_2 = false;  ms1000tick\_2 = false;    shift\_up = true;  shift\_down = false;  stay\_2 = false;  }          }    void **horizontalSelect**(){  if(ADC >=0 && ADC < 128){    // tick the appropiate state machine  ms100tick = true;  ms250tick = false;  ms500tick = false;  ms1000tick = false;    // shift in the appropiate direction  shift\_left = true;  shift\_right = false;  stay = false;    } else if(ADC >= 128 && ADC < 256){    // tick the appropiate state machine  ms100tick = false;  ms250tick = true;  ms500tick = false;  ms1000tick = false;      // go in the correct direction  shift\_left = true;  shift\_right = false;  stay = false;  } else if(ADC >= 256 && ADC < 384 ){  // tick the correct sm  ms100tick = false;  ms250tick = false;  ms500tick = true;  ms1000tick = false;    // go in the correct direction  shift\_left = true;  shift\_right = false;  stay = false;  } else if(ADC >= 384 && ADC < 448){  // tick the correct sm  ms100tick = false;  ms250tick = false;  ms500tick = false;  ms1000tick = true;    // go in the correct direction  shift\_left = true;  shift\_right = false;  stay = false;  } else if( ADC >= 448 && ADC < 576){    // don't tick any sm since no movement  ms100tick = false;  ms250tick = false;  ms500tick = false;  ms1000tick = false;    // go in the correct direction  shift\_left = false;  shift\_right = false;  stay = true;  } else if( ADC >= 576 && ADC < 640){  // tick the correct sm  ms100tick = false;  ms250tick = false;  ms500tick = false;  ms1000tick = true;    // go in the right direction  shift\_right = true;  shift\_left = false;  stay = false;  } else if (ADC >= 640 && ADC < 768){  //tick the correct sm  ms100tick = false;  ms250tick = false;  ms500tick = true;  ms1000tick = false;    // go in the right direction  shift\_right = true;  shift\_left = false;  stay = false;  } else if (ADC >= 768 && ADC <896){  // tick the correct sm  ms100tick = false;  ms250tick = true;  ms500tick = false;  ms1000tick = false;    // go in the right direction  shift\_right = true;  shift\_left = false;  stay = false;  } else if(ADC >= 896 && ADC <1024){  ms100tick = true;  ms250tick = false;  ms500tick = false;  ms1000tick = false;    shift\_right = true;  shift\_left = false;  stay = false;  }        }      void **tick**(){    /\*  shift\_up  shift\_down  shift\_left  shift\_right  stay  \*/      //first we must select the row  //Set\_A2D\_Pin(0x01);  //selectRow();     // then we select the column (i.e. show the LED)  Set\_A2D\_Pin(0x00);    // must have at least 1ms delay to allow the mux to have the right values selected  \_delay\_ms(5);    // select the correct speed and direction  // available to us with booleans shift\_up, shift\_down, shift\_left, shift\_right ,stay  // and with booleans ms100tick, ms250tick, ms500tick and ms1000tick  horizontalSelect();      // increment the time counter  t += 50;    if(stay){  return;  }    if(t % 100 == 0 && ms100tick){   if(shift\_right){  if( (PORTC >> 1) > 0){  PORTC = (PORTC >> 1);  }    }else if(shift\_left){  if( (PORTC << 1) > 0x80){  // do nothing  } else {  PORTC = (PORTC << 1);  }  }   // reset vaules  ms100tick = false;   }    if(t % 250 == 0 && ms250tick){  if(shift\_right){  if( (PORTC >> 1) > 0){  PORTC = (PORTC >> 1);  }  } else if(shift\_left){  if( (PORTC << 1) > 0x80){  // do nothing  } else {  PORTC = (PORTC << 1);  }  }  ms250tick = false;  }    if(t % 500 == 0 && ms500tick){  if(shift\_right){  if( (PORTC >> 1) > 0){  PORTC = (PORTC >> 1);  }  } else if(shift\_left){  if( (PORTC << 1) > 0x80){  // do nothing  } else {  PORTC = (PORTC << 1);  }  }  ms500tick = false;  }    if(t % 1000 == 0 && ms1000tick){  if(shift\_right){  if( (PORTC >> 1) > 0){  PORTC = (PORTC >> 1);  }  } else if(shift\_left){  if( (PORTC << 1) > 0x80){  // do nothing  } else {  PORTC = (PORTC << 1);  }    }  ms1000tick = false;  }    if(t >= 5000){  t = 0;  } }  void **tick\_2**(){  /\*  shift\_up  shift\_down  stay\_2  \*/      //first we must select the row  Set\_A2D\_Pin(0x01);  //selectRow();    // must have at least 1ms delay to allow the mux to have the right values selected  \_delay\_ms(5);      // select the correct vertical row  vertSelect();      if(stay\_2){  return;  }    t\_2 += 50;    if(t\_2 % 100 == 0 && ms100tick\_2){  if(shift\_up){  if( ( (PORTD >> 1) | 0x80) != 0xFF){  PORTD = (PORTD >> 1) | 0x80;  }  } else if(shift\_down){  if( ( (PORTD << 1) + 0x01) != 0xFF){  PORTD = (PORTD << 1) + 0x01;  }  }   }    if(t\_2 % 250 == 0 && ms250tick\_2){  if(shift\_up){  if( ( (PORTD >> 1) | 0x80) != 0xFF){  PORTD = (PORTD >> 1) | 0x80;  }  }  else if(shift\_down){  if( ( (PORTD << 1) + 0x01) != 0xFF){  PORTD = (PORTD << 1) + 0x01;  }  }  }    if(t\_2 % 500 == 0 && ms500tick\_2){  if(shift\_up){  if( ( (PORTD >> 1) | 0x80 ) != 0xFF){  PORTD = (PORTD >> 1) | 0x80;  }  }  else if(shift\_down){  if( ( (PORTD << 1) + 0x01) != 0xFF){  PORTD = (PORTD << 1) + 0x01;  }    }  }    if(t\_2 % 1000 == 0 && ms1000tick\_2){  if(shift\_up){  if( ( (PORTD >> 1) | 0x80) != 0xFF){  PORTD = (PORTD >> 1) | 0x80;  }  }  else if(shift\_down){  if( ( (PORTD << 1) + 0x01) != 0xFF){  PORTD = (PORTD << 1) + 0x01;  }  }  }        if(t\_2 >= 5000){  t\_2 = 0;  } }      int **main**(void) {  A2D\_init();  TimerSet(50);  TimerOn();    /\* Replace with your application code \*/  DDRA = 0x00; PORTA = 0xFF; // PORTA Input  DDRD = 0xFF; PORTD = 0x00; // PORTD Output  DDRC = 0xFF; PORTC = 0x00; // PORTC Output    // initialize to zeroth index  PORTD = 0xFE;  PORTC = 0x08;  while (1) {    while(!TimerFlag);  TimerFlag = 0;    tick();  tick\_2();  // first we must select the row  //Set\_A2D\_Pin(0x01);  //selectRow();    // must have at least 1ms delay to allow the mux to have the right values selected  //\_delay\_ms(5);    // then we select the column (i.e. show the LED)  //Set\_A2D\_Pin(0x00);  //displayCol();    //PORTC = ADC;  //PORTD = 0xFE;    } } |