DESCRIPTION

The Kimat – LED bar module is originally designed as a quick I/O state tester. However, the present design also works as a general purpose display using an 8-segment LED bar for applications such as battery level indication, equalizer display or perhaps as a sensor level indicator. Unique to this module are the input headers. The headers are arranged for quick connection to any of your Arduino headers with just one or no wire at all. There is also an onboard 8-channel DIP switch that allows the user to enable/disable each LED segment. This may be useful in cases where not all adjacent pins are intended to be used with the LED segments (e.g. some pin are an inputs).

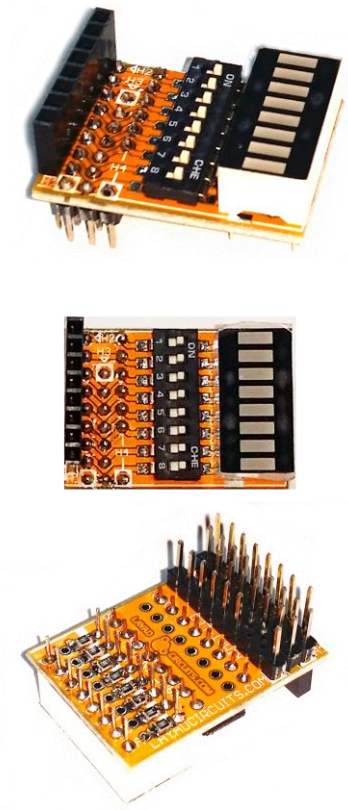

Figure 1: The Kimat-LED bar module

FEATURES

- 8 channel LED display using an 8 segment LED module
- Individual enable/disable switch for each channel
- Arduino-compatible pin headers. Requires none or just 1 wire to connect to an Arduino. Installs like a "shield"
- Compatible with 5 or 3.3V circuits
- Low power. ~5mA per channel @ 5V. ~3.3mA @3.3V.

APPLICATIONS

- General Purpose LED display
- GPIO State Tester
- Battery Level Indicator
- Signal Level Indicator
- Sensor reading Indicator
- Equalizer / VU meter

SCHEMATIC

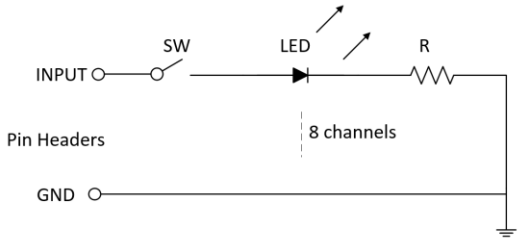

Figure 2: Schematic diagram

The schematic in figure 2 shows just one of the 8 available channels on the module. All channels have an identical circuit. SW represents one channel on the DIP switch while LED represent a segment in the LED bar.

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APPLICATION NOTES

The onboard DIP switch

The onboard low profile DIP switch allows the user to individually enable or disable the LED channels. When in the ON position, the corresponding LED shall light on or off according to the logic level of the corresponding input header. The switch may be turned OFF if the particular GPIO attached to the input header is desired not to be used with the LED bar. In this case, simply use the female header at the top side to connect whatever circuit you need on that pin. This is useful when adjacent pins have different functions such as when some pins are outputs and some are inputs.

Headers

There are 4 pin headers on the Kimat-LED bar module labeled H1 ~ H4. Figure 3 shows what may be seen from the bottom side of the module. The labels are highlighted in yellow. H1 and H2 have all channels (A-H) connected. H3 connects to channel A ~ F while H4 connects to channels C~H. Pins with a white box are ground pins. Pins of the same channel are connected to the same point. Ground pins are common.

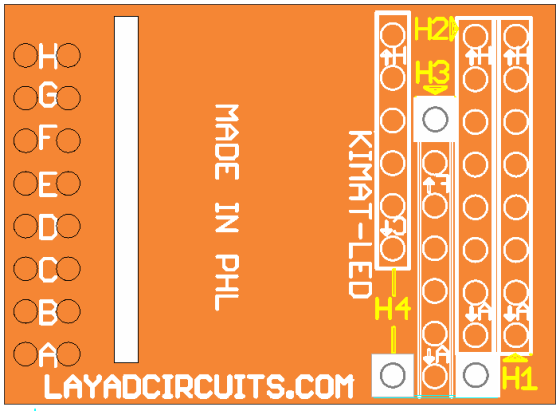

Figure 3:: Labels seen from Bottom layer

Header H1

H1 is a stackable 8 pin header with male pins at the bottom and female pins on top. The female pins give access to the male headers below. Use these to connect to other circuits similar as in a full pledged Arduino "shield". The male pins give 8 adjacent pins for general purpose connection. This is ideally useful on the D0~D7 female pin header of the Arduino UNO/Mega or in any header without a nearby ground point. Connect any of the ground pins on the module to any ground pin on the Arduino with a wire connector.

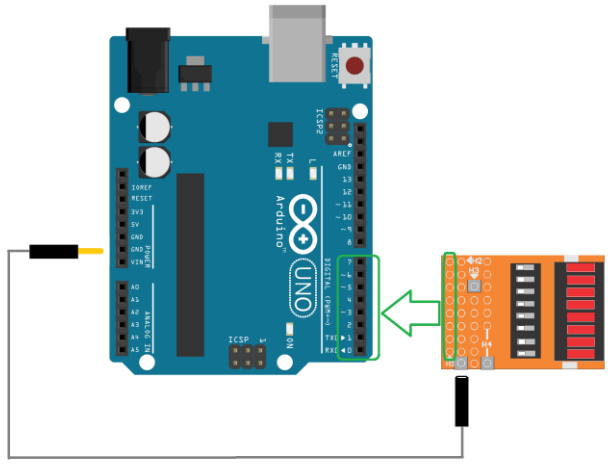

Figure 4: H1 to D0~D7 header

Header H2

H2 is a 9 pin male header. The pin with a white square marks the ground pin. The other 8 are connected to channels A~H. H2 is general purpose and may be used with 9 wires and connected separately to pins you desire. Connect any of the ground pins on the module to any ground pin on the Arduino.

This header may also be connected directly to any 8-pin digital pin header with the last pin (GND pin) set as an

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OUTPUT and initialized as LOW in the code. This connects only 7 of the LED segments but eliminates the need for a ground wire. See figure 5 and 6.

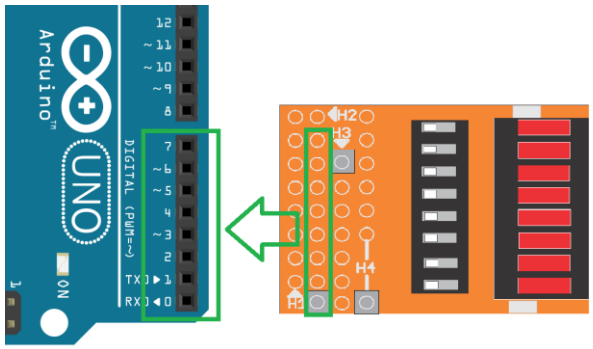

Figure 5: H2 to D0~D7 header

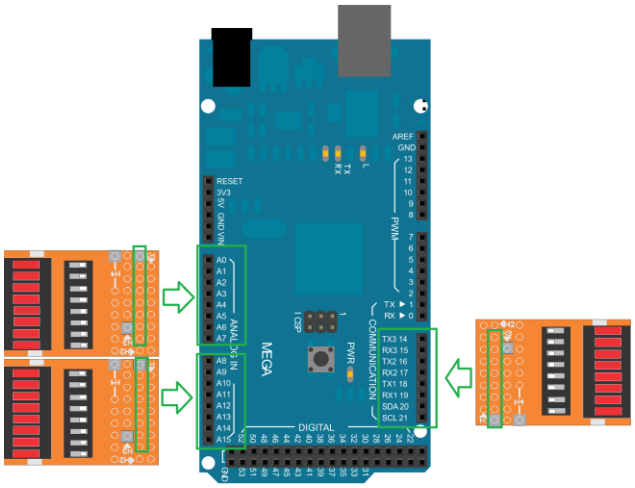

Figure 6: Connection possibilities with H2 header on the Arduino Mega

Figure 5 has the following connections:

Arduino/Saleng UNO / Mega / Leonardo / Etc. pins: Figure 5	Arduino Mega pins: Figure 6			Kimat – LED Bar Module H2 Header
0	21	A0	A8	GND
1	20	A1	A9	A
2	19	A2	A10	B
3	18	A3	A11	C
4	17	A4	A12	D
5	16	A5	A13	E
6	15	A6	A14	F
7	14	A7	A15	G
Not Connected				H

Pins highlighted in blue are used as ground return pins and should be set as an OUTPUT and initialized as LOW in the code. Channel H is not connected in this case.

Header H3

Pin header H3 has 7 male pins, one is GND and the 6 other are connected to channels A ~ F. This header is purposely meant for D8~D13 header of the Arduino UNO/Mega/Leonardo or other boards of similar form. In the Arduino, there is a GND pin after D13 and is used as ground point by the Kimat LED Bar module. No wire is required in this case. Channels G and H are unused.

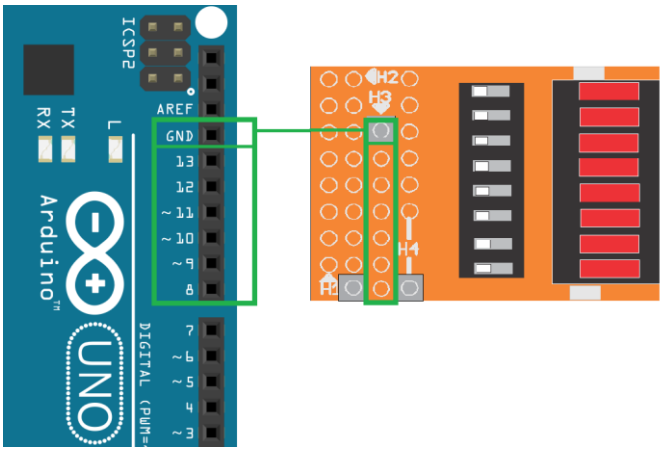

Figure 7: H3 to D8~D13 header

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Header H4

Header H4 consists of 6 adjacent male headers connected to channels C~H and a separate GND pin at a 2-pin distance from the pin of channel C. This unique arrangement allows H4 to be connected directly to the A0~A5 header of the Arduino without wiring. The GND pin of the Arduino beside VIN pin is utilized by the module as ground pin. Refer to figure 8.

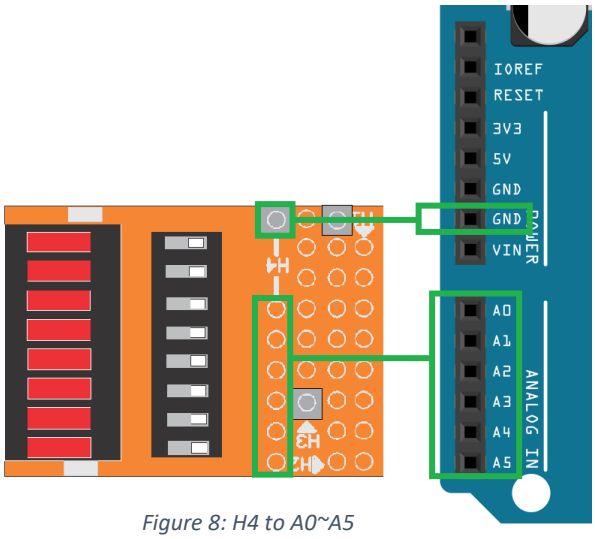

Figure 8: H4 to A0~A5

Digital State Tester for Arduino

If you want to instantly determine the output state, whether Low or High, of your Arduino/Saleng Uno pins, then this module is what you need. With the minimal connections required, simply connect the module as in the previous figures. No coding is required, just set which pins should be enabled or disabled using the DIP switch and connect the module accordingly. When the particular output pin goes HIGH, the corresponding LED segment should light up. It should turn off when the pin is LOW. This module may be a lot more effective and efficient that using a voltmeter just to check logic states. Do note however that the resistor and LED of the module connects directly to the Arduino pins. In some cases, you may want to check what other circuits are connected to the pin.

Analog Signal Level Indicator

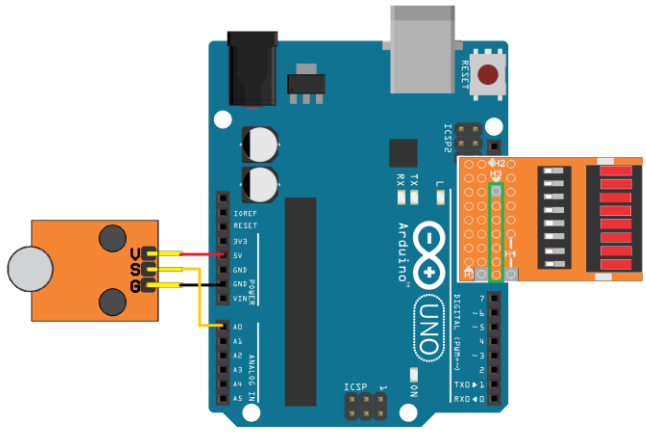

Figure 9: Thermometer display example

Any quantity that can be represented by a maximum of 8 discrete levels may be displayed using the Kimat LED bar module. The following example shows how to use the module as a simple thermometer display using the Kimat - LM35 as sensor.

The basic code may be done as in this example:

```
byte LED_A = 8;
byte LED_B = 9;
byte LED_C = 10;
byte LED_D = 11;
byte LED_E = 12;
byte LED_F = 13;
byte LM35 = A0;
float temperature;

void setup() {
  pinMode(LED_A,OUTPUT);
  pinMode(LED_B,OUTPUT);
  pinMode(LED_C,OUTPUT);
  pinMode(LED_D,OUTPUT);
  pinMode(LED_E,OUTPUT);
```

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```
  pinMode(LED_F,OUTPUT);
}

void loop() {
  // read the ADC & convert to deg.Celsius
  temperature = analogRead(A0)*0.48828125;

  if(temperature<=18.0)
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,LOW);
    digitalWrite(LED_C,LOW);
    digitalWrite(LED_D,LOW);
    digitalWrite(LED_E,LOW);
    digitalWrite(LED_F,LOW);
  }
  else if(temperature<=21.0)
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,HIGH);
    digitalWrite(LED_C,LOW);
    digitalWrite(LED_D,LOW);
    digitalWrite(LED_E,LOW);
    digitalWrite(LED_F,LOW);
  }
  else if(temperature<=24.0)
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,HIGH);
    digitalWrite(LED_C,HIGH);
    digitalWrite(LED_D,LOW);
    digitalWrite(LED_E,LOW);
    digitalWrite(LED_F,LOW);
  }
  else if(temperature<=27.0)
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,HIGH);
    digitalWrite(LED_C,HIGH);
    digitalWrite(LED_D,HIGH);
    digitalWrite(LED_E,LOW);
    digitalWrite(LED_F,LOW);
  }
  else if(temperature<=30.0)
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,HIGH);
    digitalWrite(LED_C,HIGH);
    digitalWrite(LED_D,HIGH);
    digitalWrite(LED_E,HIGH);
    digitalWrite(LED_F,LOW);
  }
  else
  {
    digitalWrite(LED_A,HIGH);
    digitalWrite(LED_B,HIGH);
    digitalWrite(LED_C,HIGH);
    digitalWrite(LED_D,HIGH);
    digitalWrite(LED_E,HIGH);
    digitalWrite(LED_F,HIGH);
  }
}
```

The previous code may not be as efficient code-wise. The following example improves on the code with the same results:

```
byte LED_A = 8;
byte LED_B = 9;
byte LED_C = 10;
byte LED_D = 11;
byte LED_E = 12;
byte LED_F = 13;
byte LM35 = A0;
byte LEDS[6] =
{LED_A,LED_B,LED_C,LED_D,LED_E,LED_F};
byte bitState; // LSB represents LED A
float temperature;

void setup() {
  for(byte i=0;i<6;i++) {
  pinMode(LEDS[i],OUTPUT);
  }
}

void loop() {
  // read the ADC & convert to deg.Celsius
  temperature = analogRead(A0)*0.48828125;
  if(temperature <= 18.0) bitState = 0b000001;
  else if(temperature <= 21.0) bitState = 0b000011;
  else if(temperature <= 24.0) bitState = 0b000111;
  else if(temperature <= 27.0) bitState = 0b001111;
  else if(temperature <= 30.0) bitState = 0b011111;
  else bitState = 0b111111;

  for(byte i=0;i<6;i++)
    digitalWrite(LEDS[i],bitState>>i);
}
```

By modifying the input value being displayed, previous examples shows how to display just about any value that you could divide in 6 discrete steps. You could use up to 8 steps but you will have to connect the 2 unused channels.

Below are some examples of values you could divide in up to 8 steps or 8 “bars”:

- Distance obtained from a distance meter such as Ultrasonic or IR distance sensor
- Signal level from a GSM module (e.g. obtained by AT+CSQ command)
- Volume level coming from a Sound sensor
- Approximate position of a potentiometer knob/slide
- Level of a certain gas from a gas sensor
- Light level sensed from an LDR/Photodiode
- Volume level

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- Weight level from a loadcell
- Battery Level (see the next note)
- Multi line/channel indicator
- RSSI indicator
- And many more

Battery Level Indicator

One popular application of a LED bar as in the Kimat LED bar module is for battery level indication. The following example shows both circuit and code using the Kimat Voltage sensor module as battery voltage sensor.

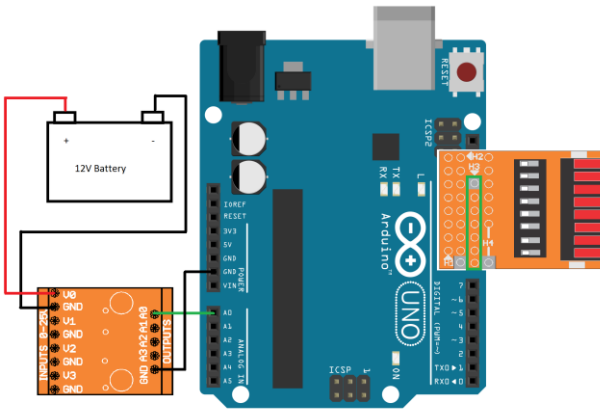

Figure 10: Battery Level Indicator using the Kimat Voltage Sensor and Kimat LED Bar modules

```
byte LED_A = 8;
byte LED_B = 9;
byte LED_C = 10;
byte LED_D = 11;
byte LED_E = 12;
byte LED_F = 13;
byte LEDS[6] =
{LED_A,LED_B,LED_C,LED_D,LED_E,LED_F};
byte bitState; // LSB represents LED A
float Vbatt;

float adc2volts(unsigned int adc)
{
  float r1 = 20000;
  float r2 = 4700;
  return (((float)(adc*5))/1024.0)  * (r1+r2) / r2;
}

void setup() {
  for(byte i=0;i<6;i++) {
  pinMode(LEDS[i],OUTPUT);
  }
}

void loop() {
  // read the ADC & convert to battery voltage
  Vbatt = adc2volts(analogRead(A0));
  if(Vbatt <= 9.0) bitState = 0b000001;
  else if(Vbatt <= 10.0) bitState = 0b000011;
  else if(Vbatt <= 11.0) bitState = 0b000111;
  else if(Vbatt <= 12.0) bitState = 0b001111;
  else if(Vbatt <= 13.0) bitState = 0b011111;
  else bitState = 0b111111;

  for(byte i=0;i<6;i++)
    digitalWrite(LEDS[i],bitState>>i);
}
```

Distance or Collision Indicator

As an example application of a distance indicator, it may be desired that a mobile robot instantly feedback the

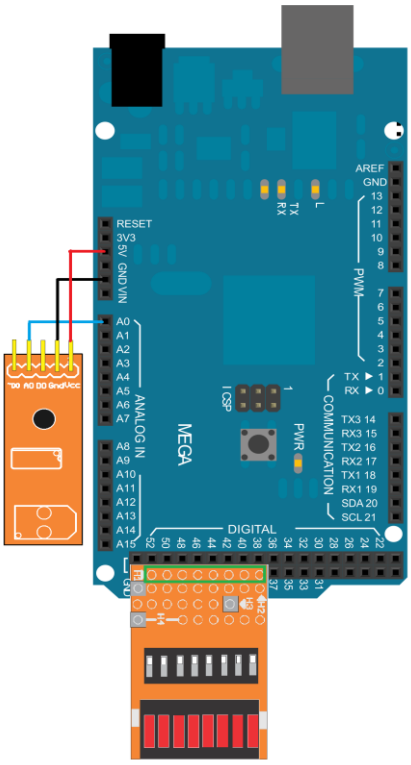

Figure 11: A distance indicator using the Saleng Tracker as distance sensor and the Kimat LED bar module with an Arduino Mega

approximate distance of a detected obstacle to its human operator via the Kimat LED bar module.

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The following example uses an Arduino Mega, the Saleng Tracker as distance sensor and the Kimat LED bar module. The LED bar module is using pins 53,51,49,47,45,43,41,and 39 of the Arduino for channels A~H respectively. The Saleng Tracker is connected to A0 via its analog output pin AO. When an obstacle comes close, more of the segments light up.

```
byte LED_A = 53;
byte LED_B = 51;
byte LED_C = 49;
byte LED_D = 47;
byte LED_E = 45;
byte LED_F = 43;
byte LED_G = 41;
byte LED_H = 39;
byte LEDS[8] =
{LED_A,LED_B,LED_C,LED_D,LED_E,LED_F,LED_G,LED_H};
byte bitState; // LSB represents LED A
int dist;

void setup() {
  for(byte i=0;i<8;i++) {
  pinMode(LEDS[i],OUTPUT);
  }
  Serial.begin(9600);
}

void loop() {
   dist = analogRead(A0);
   Serial.println(dist);
   if(dist <= 200) bitState = 0b11111111;
   else if(dist <= 400) bitState = 0b01111111;
   else if(dist <= 600) bitState = 0b00111111;
   else if(dist <= 860) bitState = 0b00011111;
   else if(dist <= 890) bitState = 0b00001111;
   else if(dist <= 905) bitState = 0b00000111;
   else if(dist <= 930) bitState = 0b00000011;
   else  bitState = 0b00000001;

  for(byte i=0;i<8;i++)
    digitalWrite(LEDS[i],bitState>>i);
}
```

Using an Arduino pin as ground pin

The following code segment shows how to use the module using one GPIO of the Arduino as a ground return path. We simply set this as an OUTPUT and set it LOW under setup(). The module must then use header H2 and connect Arduino D0 to the GND pin. Only channels A~G are useable with channel H unconnected.

```
void setup() {
  pinMode(0,OUTPUT);
  digitalWrite(0, LOW);
  for(byte i=0;i<8;i++) {
  pinMode(LEDS[i],OUTPUT);
 //…
}
```

With this arrangement, care must be taken as the total current drawn is around 35mA when all 7 LED segments are turned on. That is very close to 40mA limit of most AVR-based Arduino boards.

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