OVERVIEW

The 8 Channel Saleng Tracker Module is an array of 8 infrared sensors designed for line or simple color sensing and general purpose proximity sensing. An on board RISC processor takes care of all sensor processing and therefore lessens software load on the main host. There are two concurrent interface ports: a serial (UART) and parallel output ports, one for each sensor element. The module uses infrared elements that come with built-in sunlight filter providing improved performance in sunlit areas than traditional photodiodes.

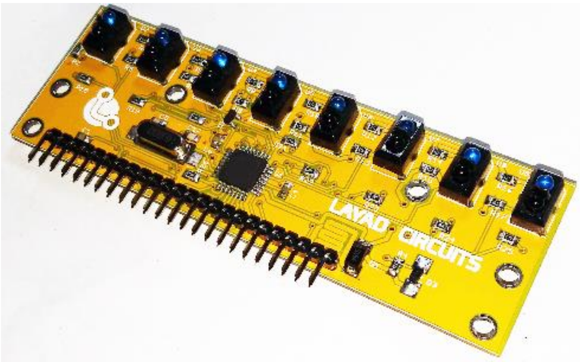

Figure 1 8CH Saleng Tracker

FEATURES

- Onboard RISC processor
- UART and Parallel interface
- Individual LED indicator per sensor element
- Reversible logic for parallel port and LED indicators
- Adjustable sensor threshold
- Multiple output modes using the UART interface
- On chip power saving feature resulting to <200mA consumption. Typical consumption with all LED on ~ 150mA.
- Standard headers
- Power indicator
- Designed primarily for Arduino users

PIN FUNCTIONS

The module has a 4 pin 2.54mm pitched header with the following functions.

Pin Label	Function/Operation/Remarks
VIN	+5Vdc. This is the power source for the module
GND	Ground pin.
RXD	Receive pin of the serial/UART port – connects to the transmit pin of the host microcontroller (Arduino etc..)
TXD	Transmit pin of the serial/UART port – connects to the receive pin of the host microcontroller (Arduino etc..)
I0 – I7	Parallel port pins. By default, white(reflective) surfaces will result to a HIGH and dark or non reflective surfaces will result to a LOW on each of these pins corresponding the sensor
All others	Do not use

PARALLEL PORT INTERFACE

Use this port (I0-I7) for simplified programming. Connect each of the pins to digital input pins on your host (Arduino etc..). I0 represents the status of sensor 0 while I7 represents the status of sensor 1. By default, each pin is HIGH if the corresponding sensor element detects a white/reflective surface in front of it. It is LOW if the sensor element does not see a reflective surface. The logic state may be reversed using the inverse command that may be sent via serial port. The LED indicators follow whatever is the actual logic state of the parallel port e.g. LED is ON when pin is HIGH.

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com Sales: sales@layadcircuits.com FB: facebook.com/layadcircuits Mobile: +639164428565

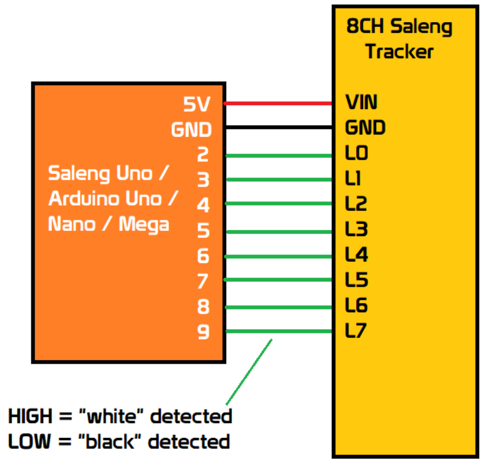

Figure 2 Example connection using the parallel port

Test Code for Parallel Mode

```
void setup() {
  Serial.begin(9600);
  pinMode(2,INPUT); //L0
  pinMode(3,INPUT); //L1
  pinMode(4,INPUT); //L2
  pinMode(5,INPUT); //L3
  pinMode(6,INPUT); //L4
  pinMode(7,INPUT); //L5
  pinMode(9,INPUT); //L6
  pinMode(8,INPUT); //L7
}

void loop() {
  Serial.print("I0=");
  Serial.println(digitalRead(2));
  Serial.print("I1=");
  Serial.println(digitalRead(3));
  Serial.print("I2=");
  Serial.println(digitalRead(4));
  Serial.print("I3=");
  Serial.println(digitalRead(5));
  Serial.print("I4=");
  Serial.println(digitalRead(6));
  Serial.print("I5=");
  Serial.println(digitalRead(7));
  Serial.print("I6=");
  Serial.println(digitalRead(8));
  Serial.print("I7=");
  Serial.println(digitalRead(9));
  Serial.println();
  delay(500);
}
```

SERIAL PORT INTERFACE

To save input pins, the user may opt to use the serial port interface requiring only 2 pins (hardware or software serial port). The serial port interface allows the user to read each sensor element in 3 output formats and send configuration commands to the module. The serial port is set to the following UART parameters:

- 9600 baud rate
- 8 data bits
- No parity
- 1 Stop bit

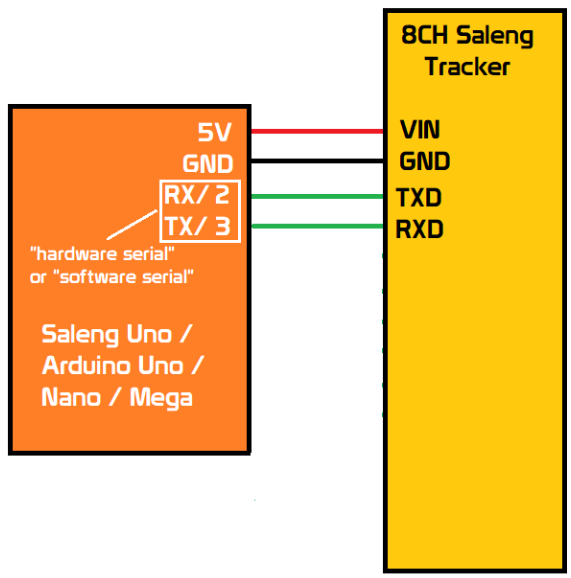

Figure 3 Example connection using the serial port

SERIAL PORT COMMANDS

The following commands are sent from the host microcontroller to the sensor board.

In general, a command starts with an '&', followed by the command and then finally ended with a '\r' (Carriage Return) and optionally a '\n' (New line).

Command String	Function
&M0\r	Sets the output format to Mode 0. In this mode, the output string is formatted as follows: @xxxxxxxx#\r\n Where x is either '0' or '1' representing the state of each sensor element. For example, when the first 4 sensors detect "white" and the others detect "black", expect to receive the string "@11110000#\r\n" This command takes about 0.2 second or less to execute.
&M1\r	Sets the output format to Mode 1. In this mode, the output string is formatted as follows: @xxxxxxxx#\r\n Where x is a letter from a to h corresponding the sensor elements and where an upper case represents a "white" and a lower case, a "black". For example, when the first 4 sensors detect "white" and the others detect "black", expect to receive the string "@ABCDefgh#\r\n" This command takes about 0.2 second or less to execute.
&M2\r	Sets the output format to Mode 2. In this mode, there is a single byte output. Each bit represents the state of the 8 sensor elements. For example, when the first 4 sensors detect "white" and the others detect "black", expect to receive the byte B11110000 or 0xF0 in hex. This command takes about 0.2 secondsor less to execute.
&M3\r	Sets the output format to Mode 3. In this mode, the output per sensor element is a number from 00 to 99 representing the intensity of the reflected IR signal. Example: @,01,99,02,98,03,97,04,96,# This command takes about 0.2 second or less to execute.
&Txx\r	Sets the threshold/sensitivity of the IR sensor elements. Set xx to any number between 00 and 99. Keep single digit numbers as 2 digits. Example: &T05#\r This command takes about 0.1 second or less to execute.
&I0\r or &I1\r	Enable/Disable Inverse Setting - this command toggles the logic level of the LEDs and I0-I7. This command takes about 0.1 second or less to execute.
&FACTORY#\r	Reset to factory default settings. This takes around 1.5 seconds or less to execute.

APPLICATION NOTES

SELECTING INTERFACE PORT AND MODE

Parallel Port Interface – use this for simplified programming at the expense of 8 digital inputs

Serial Port Interface – use this to save pins. This port requires a free hardware or software emulated serial port.

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com Sales: sales@layadcircuits.com FB: facebook.com/layadcircuits Mobile: +639164428565

- Mode 0 and 1 requires collection and parsing of string from the module
- Mode 2 – bitwise operation is needed to interpret the data but parsing errors are minimal given that there is a single byte to process
- Mode 3 – useful if the host will perform the processing of the data. This may be used as a crude distance or color sensor sensor.

BASIC EXAMPLE: LINE TRACING and SERIAL MODE

This build uses the **Kimat MOBOT Shield** (mark 1) as its driver board. The objective is to create a line follower robot assuming the line is continuous without breaks. It is assumed the line is dark while the background is light.

Wiring

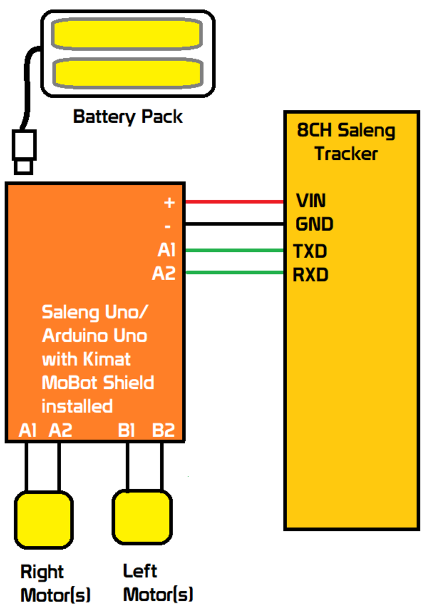

Figure 4 Line Tracing with Serial Mode

Code

```
#include <SoftwareSerial.h>

SoftwareSerial mySerial(A1, A2); // RX, TX

char SenseValue[8];
char ReadValue;
byte Index;
int LeftLevel,RightLevel,TurnValue;
#define BLK LOW  // line
#define WHT HIGH // background

// speed setting based on movement
// 255=full speed
#define SPEED_ON_TURNS 120
#define SPEED_FORWARD 100
#define SPEED_BACKWARD 100

#define AIN1 2
#define BIN1 7
#define AIN2 4
#define BIN2 5
#define PWMA 3
#define PWMB 6
#define STBY 8
#define SENSOR_L A0
#define SENSOR_C 11
#define SENSOR_R 10

unsigned long timer_rx;
char buf[13]="";
byte i;

void speedSetting(byte val)
{
  analogWrite(PWMA,val);
  analogWrite(PWMB,val);
}

void forward()
{
  speedSetting(SPEED_FORWARD);
  digitalWrite(AIN1,LOW);
  digitalWrite(AIN2,HIGH);
  digitalWrite(BIN1,LOW);
  digitalWrite(BIN2,HIGH);
}

void backward()
{
  speedSetting(SPEED_BACKWARD);
  digitalWrite(AIN1,HIGH);
  digitalWrite(AIN2,LOW);
  digitalWrite(BIN1,HIGH);
```


Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com   Sales: sales@layadcircuits.com   FB: facebook.com/layadcircuits   Mobile: +639164428565

```
  digitalWrite(BIN2,LOW);
}

void turnleft()
{
  speedSetting(SPEED_ON_TURNS);
  digitalWrite(AIN1,LOW);
  digitalWrite(AIN2,HIGH);
  digitalWrite(BIN1,HIGH);
  digitalWrite(BIN2,LOW);
}

void turnright()
{
  speedSetting(SPEED_ON_TURNS);
  digitalWrite(AIN1,HIGH);
  digitalWrite(AIN2,LOW);
  digitalWrite(BIN1,LOW);
  digitalWrite(BIN2,HIGH);
}
void motorstop()
{
  digitalWrite(AIN1,LOW);
  digitalWrite(AIN2,LOW);
  digitalWrite(BIN1,LOW);
  digitalWrite(BIN2,LOW);
}

void shortbreak()
{
  digitalWrite(AIN1,HIGH);
  digitalWrite(AIN2,HIGH);
  digitalWrite(BIN1,HIGH);
  digitalWrite(BIN2,HIGH);
}

void setup() {
  pinMode(AIN1,OUTPUT);
  pinMode(AIN2,OUTPUT);
  pinMode(BIN1,OUTPUT);
  pinMode(BIN2,OUTPUT);
  pinMode(STBY,OUTPUT);
  digitalWrite(STBY,HIGH);//enable driver
  //we use a slow speed to avoid
  // overshooting lines
  // and conserve battery
  // full speed = 255
  speedSetting(64);
  mySerial.begin(9600);
  Serial.begin(9600);

  mySerial.println("&M0#/r/n"); //ensure that sensor output is mode 0
  delay(2000); // add 4s delay
  mySerial.println("&T20/r/n");// set the threshold to 20 out of 99
}
```


Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com Sales: sales@layadcircuits.com FB: facebook.com/layadcircuits Mobile: +639164428565

```
void loop()
{
  // if there is data, we collect the string.
  //in mode 0 we expect this: @00001111#\r\n
  //where the 0's and 1's represent the state of the sensor elements
  if(mySerial.available())
  {
    timer_rx = millis();
    memset(buf,0,13);
    i=0;
    while(millis() - timer_rx <50)
    {
      if(mySerial.available())
      {
        char c;
        c = mySerial.read();
        if(c=='@')
        {
          i=0;
          buf[i++]=c;

        }
        else if(c=='#' || c=='\r')//we got the last char
        {
            buf[i++]=c;
            while (mySerial.available()){mySerial.read();} //clear everything else
            break;
        }
        else if(c=='0' || c=='1')
        {
          buf[i++]=c;
        }
      }

      if(i>=11) break;//exit if we reached apparant max for the incoming string
    }
  }
  Serial.println(buf);
  //now we can evaluate the data

  //check all p[osible "forward" data
  if(strstr(buf,"@11101111#") ||
     strstr(buf,"@11110111#") ||
     strstr(buf,"@11100111#") ||
     strstr(buf,"@11111111#") ||
     strstr(buf,"@11000011#"))
     {
        forward();
     }
   // check all possible "turn right" data
   else
  if(strstr(buf,"@01111111#") ||
     strstr(buf,"@10111111#") ||
     strstr(buf,"@11011111#") ||
     strstr(buf,"@00111111#") ||
     strstr(buf,"@10011111#") ||
     strstr(buf,"@11001111#") ||
```

```
      strstr(buf,"@00011111#") ||
      strstr(buf,"@10001111#") ||
      strstr(buf,"@11000111#") ||
      strstr(buf,"@00001111#") )
      {
         turnright();
      }
    // check all possible "turn left" data
    else
   if(strstr(buf,"@11111110#") ||
      strstr(buf,"@11111101#") ||
      strstr(buf,"@11111011#") ||
      strstr(buf,"@11111100#") ||
      strstr(buf,"@11111001#") ||
      strstr(buf,"@11110011#") ||
      strstr(buf,"@11111000#") ||
      strstr(buf,"@11110001#") ||
      strstr(buf,"@11100011#") ||
      strstr(buf,"@11110000#") )
      {
         turnleft();
      }
      //check possible stop condition
   else
   if( strstr(buf,"@00000000#") ) // stop whel all black
      {
       motorstop();
      }
}
```

DOCUMENT REVISION HISTORY

Revision:

v1.0.1 / 01 Feb 2020 / C.D.Malecdan
v1.0.0 / 02 Dec 2019 / C.D.Malecdan

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com Sales: sales@layadcircuits.com FB: facebook.com/layadcircuits Mobile: +639164428565

IMPORTANT NOTICE

Layad Circuits Electronics Engineering Supplies & Services (Layad Circuits) reserves the right to make corrections, enhancements, improvements and other changes to its products, services and documentations, and to discontinue any product or service. Buyers or clients should obtain the latest relevant information before placing orders and should verify that such information is current and complete. Additional terms may apply to the use or sale of Layad Circuits products and services.

Reproduction of significant portions of Layad Circuits information in Layad Circuits datasheets or user guides is permissible only if reproduction is without alteration, displays the Layad Circuits logo and is accompanied by all associated warranties, conditions, limitations, and notices. Layad Circuits is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of Layad Circuits products or services with statements different from or beyond the parameters stated by Layad Circuits for that product or service voids all express and any implied warranties for the associated Layad Circuits product or service. Layad Circuits is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate Layad Circuits products (collectively, “Designers”) understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all Layad Circuits products used in or for Designers’ applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include Layad Circuits products, Designer will thoroughly test such applications and the functionality of such Layad Circuits products as used in such applications. Layad Circuits’ provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, “Layad Circuits Resources”) are intended to assist designers who are developing applications that incorporate Layad Circuits products; by downloading, accessing or using Layad Circuits Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer’s company) agrees to use any particular Layad Circuits Resource solely for this purpose and subject to the terms of this Notice.

Layad Circuits' provision of Layad Circuits Resources does not expand or otherwise alter Layad Circuits’ applicable published warranties or warranty disclaimers for Layad Circuits products, and no additional obligations or liabilities arise from Layad Circuits providing such Layad Circuits Resources.

Layad Circuits reserves the right to make corrections, enhancements, improvements and other changes to its Layad Circuits Resources. Layad Circuits has not conducted any testing other than that specifically described in the published documentation for a particular Layad Circuits Resource.

NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER LAYAD CIRCUITS INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF LAYAD CIRCUITS OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which Layad Circuits products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of Layad Circuits Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from Layad Circuits under the patents or other intellectual property of Layad Circuits. Layad Circuits RESOURCES ARE PROVIDED “AS IS” AND WITH ALL FAULTS. LAYAD CIRCUITS DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. LAYAD CIRCUITS SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN LAYAD CIRCUITS RESOURCES OR OTHERWISE. IN NO EVENT SHALL LAYAD CIRCUITS BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF LAYAD CIRCUITS RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER LAYAD CIRCUITS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Unless Layad Circuits has explicitly designated an individual product as meeting the requirements of a particular industry standard, Layad Circuits is not responsible for any failure to meet such industry standard requirements. Where Layad Circuits specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may NOT use any Layad Circuits products in life-critical applications. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers’ own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection. Designer will fully indemnify Layad Circuits and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer’s noncompliance with the terms and provisions of this Notice.

Layad Circuits Electronics Engineering Supplies & Services, B314 Lopez Bldg., Session Rd. cor. Assumption Rd., Baguio City, Philippines
General inquiries: info@layadcircuits.com Sales: sales@layadcircuits.com FB: facebook.com/layadcircuits Mobile: +639164428565