

This device is intended to facilitate the use of a linear encoder by reducing the size of the device and the additional capability of communication across the network. It consist from two parts: main board and additional with LCD.

Lets look at composition of each:

- Main board (UB1)
 - GPIO expander
 - 4 switches for control transition stage
 - check the presence of linear encoder
 - 8 ch. ADC
 - 4 ntc (thermistors)
 - 2 humidity sensors
 - 1 potentiometer (current + position)
 - Linear encoder interface
- LCD board (UB2)
 - LCD
 - 1 button

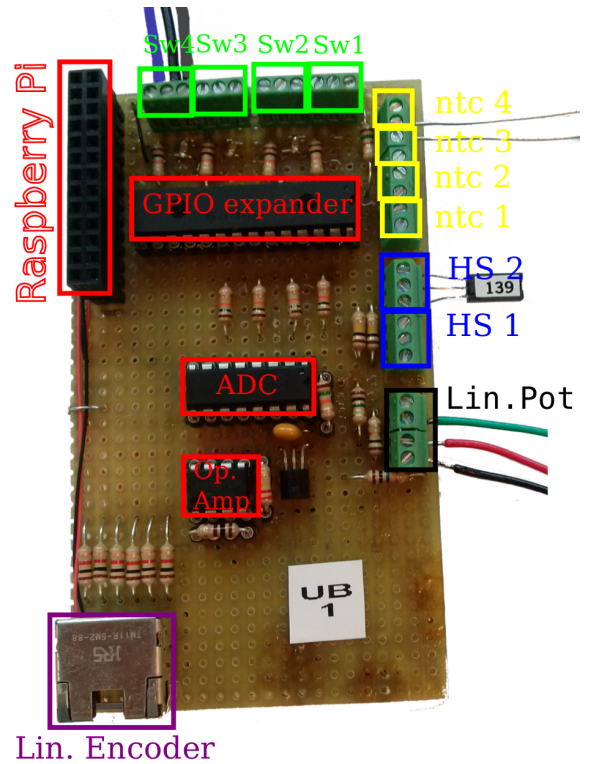


Figure 1: Main board (UB1)

Hardware part

Look for schematics of the board in the end of the document.

Device connection

- **Switches.** Board was designed for 3 wires switches. This allow to it check if switches is connected. Grey wire connected to black if swithch is not pressed and on the gpio in is zero. If yes back and blue is connected and on gpio in is logic 1. Right connection is shown on figure 1 (grey, black, blue). To check if switch is connected RPi give logic 1 on grey wire and read black, if on gpio in is 1 - switch is connected. After RPi give on grey wire 0, and switches wor in normal mode.
- **NTC** - is type of thermistor, that allow to measure temperature. There ND06Q00223J was used. At 25°C it has resistance 22k. Resistance from temperature depend exponentially:

$$R_T = Ae^{\frac{B}{T}},$$

where B=4300(K). This ntc with 10k constant resistor create voltage divider, which can readed by adc. It's also possible to check if ntc is connected. Ntc hasn't polarity, so it can be connected in any order.

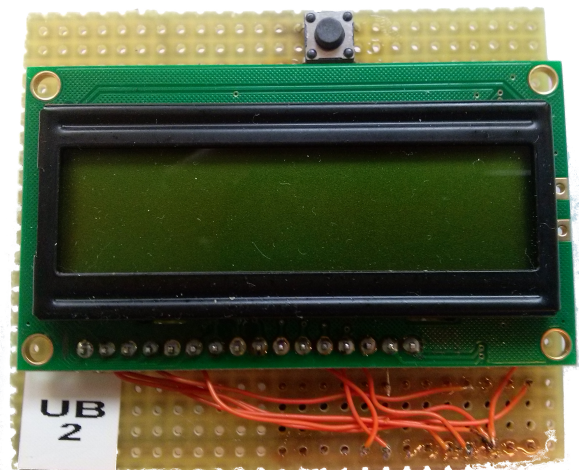


Figure 2: LCD board (UB2)

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- **Humidity sensor** (HIH-4000-004) must be connected as shown on figure. Humidity curve was taken from datasheet. Also possible to check if HS is connected.
- **Potentiometer** This board allow you measure current throw potentiometer and position of slider in current mode. Ends of potentiometer is red and black. Slider is green. Connect potentiometer as on picture.
- **LCD++** LCD module is intended to show information from linear encoder and all sensors. To improve the use button was set (it change screen with information on lcd). Firts screen (button unpressed) shows information from linear encoder, switches, humidity sensors (if last is not connected it shows -1.0). Second screen (button is pressed) show position and current of potentiometer and 4 temperature sensors (if last is not connected, it show 666). If current if very low, that mean that potentiometer is not connected (typical value for 3k3 potentiometer is 1.45mA). LCD not require any spetial pins (ordinary GPIO) and can be reconfigurable.

- **Linear encoder** Connections:

Nº	Amphenol 12	Signal	RJ45	DB15
1	B	GND	OrWt	2
2	C	A	Or	1
3	D	\bar{A}	GrWt	9
4	E	B	Bl	3
5	G	RI	BlWt	14
6	H	\bar{RI}	GR	7
7	K	+5V	BrWt	4
8	L	\bar{B}	Br	11

If time is directed to right (look at figure 5) than number sequence will be 0,1,2,3 (B-high bit,A-low bit), in other case sequence will be 1,0,2,3. If remember previous position, than it will be possible to restore direction. In our encoder each change is $10\mu m$. All combination was written to array and on each change we add 1 to counter (4 possibilities) or subtract (also 4 possibilities). In other case counter not incremented, but Errors

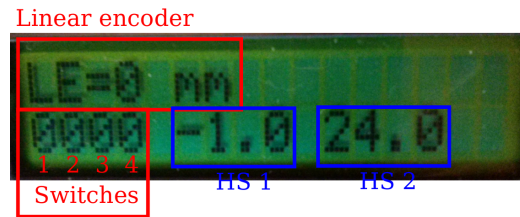


Figure 3: Screen 1

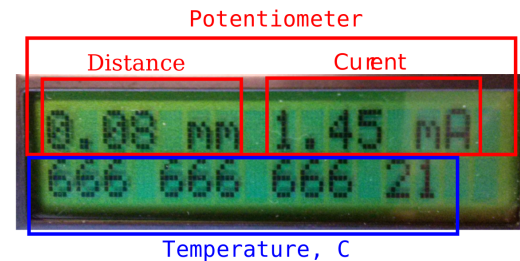


Figure 4: Screen 2

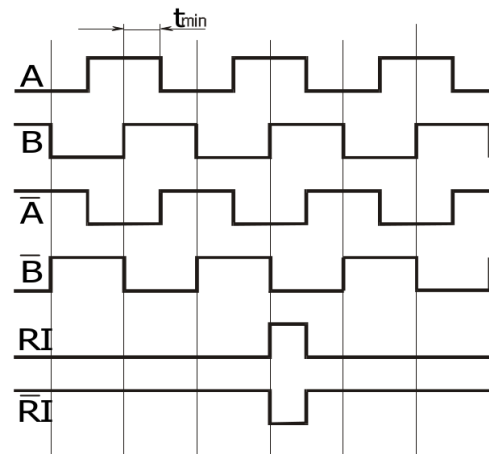


Figure 5: Signals from linear encoder

variable are. To check if linear encoder is connected \overline{RI} is used. In most cases it is 1 (except it is on zero position). As RPi GPIO are tolerant to 5V there is no 5->3.3V dividers, but only 1k shielding resistors.

Software part

Program for control all sensors and communication was written on c++. In general it has several classes for i2c, spi, lcd... Main file named main.cpp. All software could be compile with make command. Program have autostart. Program is in home directory with name Ugly_board. Script for autostart is in /etc/init.d directory and named UB.

Webpage

Also RPi can communicate with user computer throw sockets. For this type in your browser **10.0.1.155** as on figure 6 and You will get all information about sensors and presence of them.

First line in this webpage show presence of Linear encoder and switches. Rpi check it at the beginning and don't check it more! Other lines have same meaning as on LCD screen. To update information click update button in your browser.

Hope You will enjoy by this device.

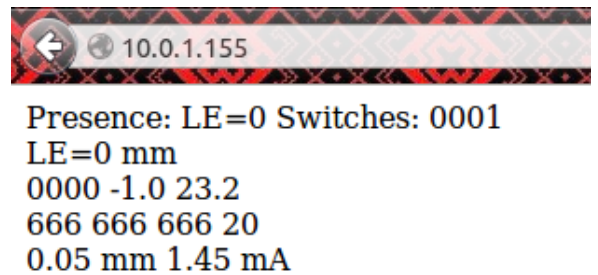
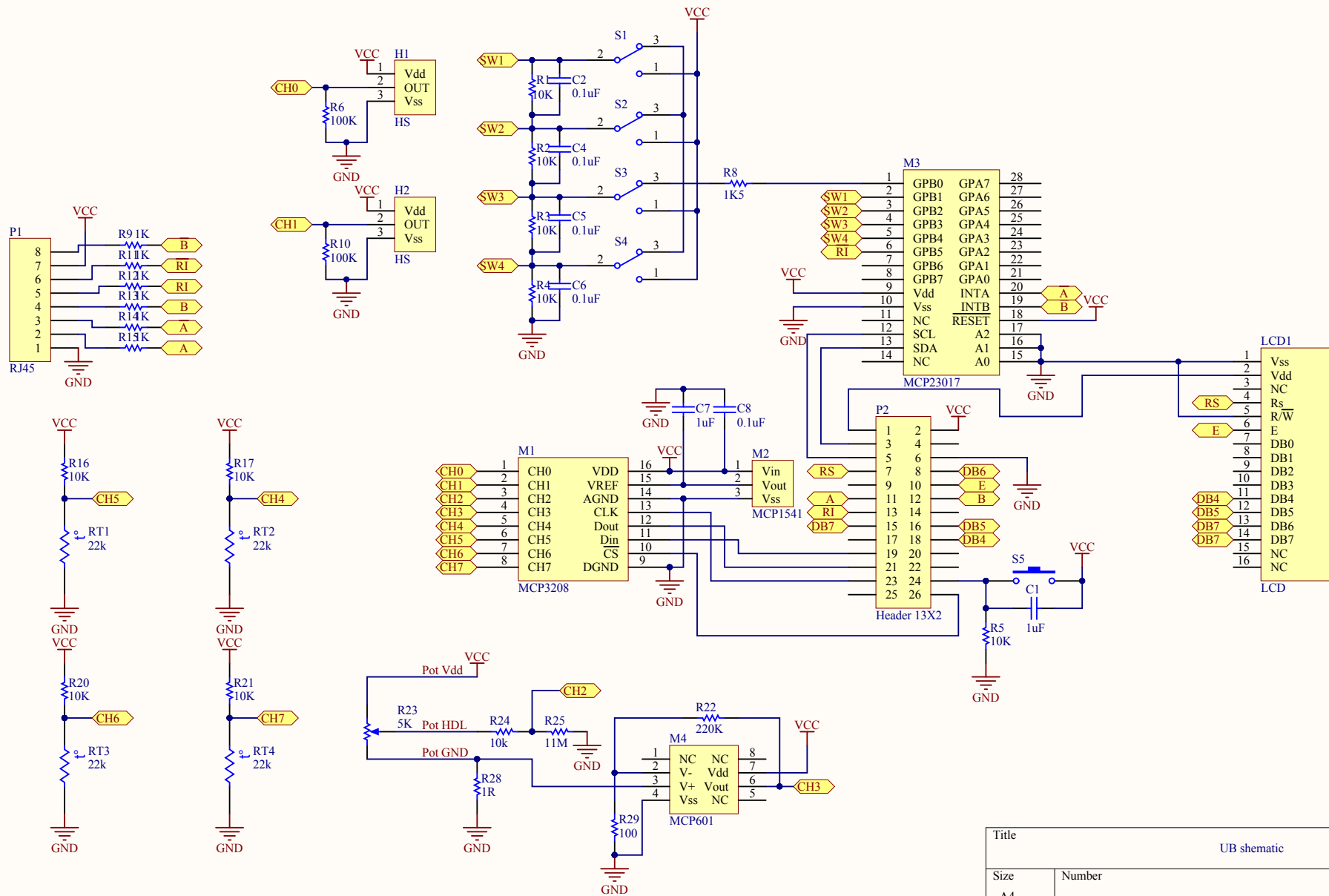


Figure 6: Webpage example



Title			UB schematic		
Size	Number			Revision	2
Date:	04.03.2015	Sheet	of		
File:	C:\Users\...\Sheet1.SchDoc	Drawn By:	Khodnevykh Vitalii		