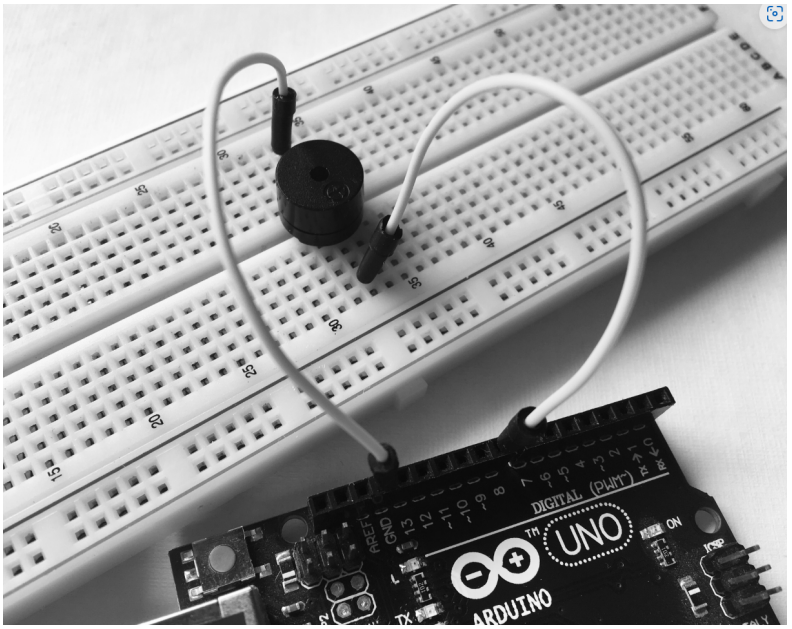
Electronic components

In the design of the syringe infusion pump, provision has been made for connection with several components.

It is important to verify that components such as buttons or switches are protected from noise that could fool the microcontroller's logic. this problem can be solved through the insertion of pull-up or pull-down resistors. it can be seen that within the ATM, there are already such resistors that can be turned on or off by software command.

For controlled and precise analysis regarding flow delivery, several sensors have been integrated:

- **BUZZERS**



Which are in charge of sound feedback. We can distinguish buzzers into magnetic and piezoelectric buzzers.

Magnetic Buzzers:

Principle of operation => coil and a flexible ferromagnetic disk, when current passes through the coil the disk is moved toward the coil and the deflection of the disk causes displacement of the surrounding air which is perceived as a sound. When the current stops flowing, the disk returns to its initial position.

Piezoelectric Buzzers:

Principle of operation => a disk of piezoelectric material is resting on the edges inside a case and electrical contacts are made on the two sides of the disk, when voltage is applied to the ends of these electrics the piezoelectric material deforms and gives rise to air movement that produces a sound.
We want to use this kind of sensors for:

Descrizione	Pin Display	Pin Arduino
VCC - Alimentazione display +5V	VCC	+5V
GND - terminale di massa	GND	GND
SDA (data line)	SDA	A4
SCL (clock line)	SCL	A5

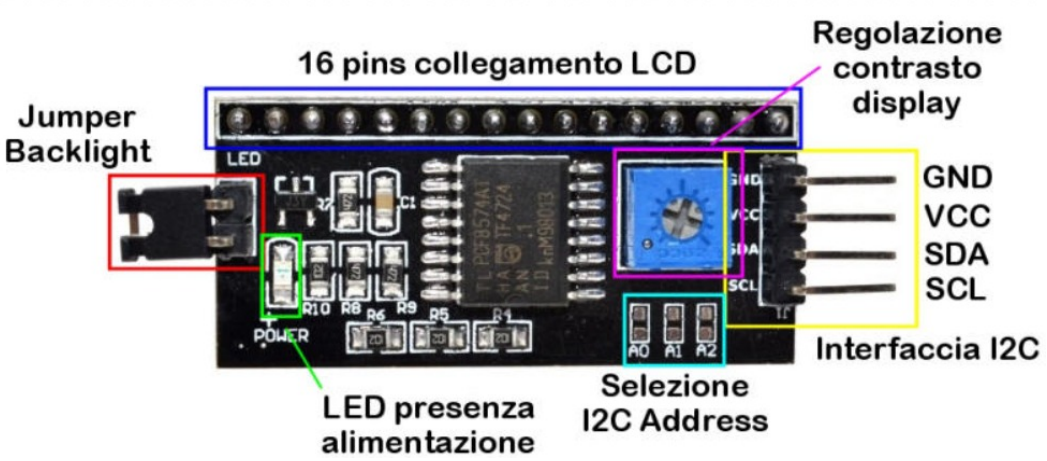
- Audible alarm indicating the start of dispensing (start of dispensing).

  Audible alarm of when the piston inside the syringe returns to its initial position (ready for new dispensing).

The buzzer used involves two pins, the negative terminal should be connected to the GND grounding pin of the Arduino Uno and the positive terminal to a digital pin.

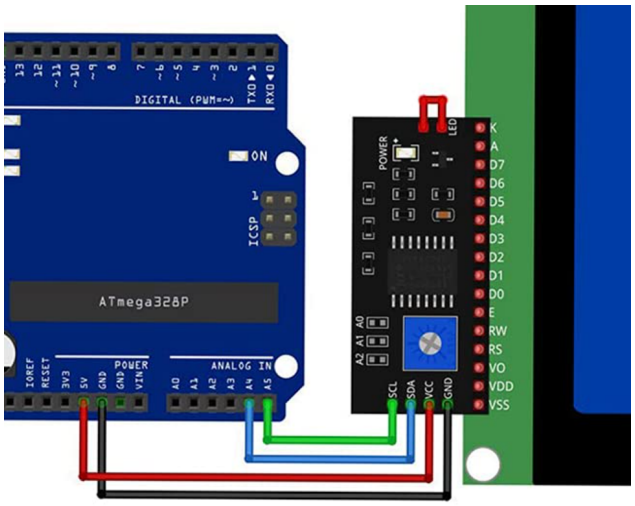
- **LCD**

As for the visual interface, an LCD display has been implemented:



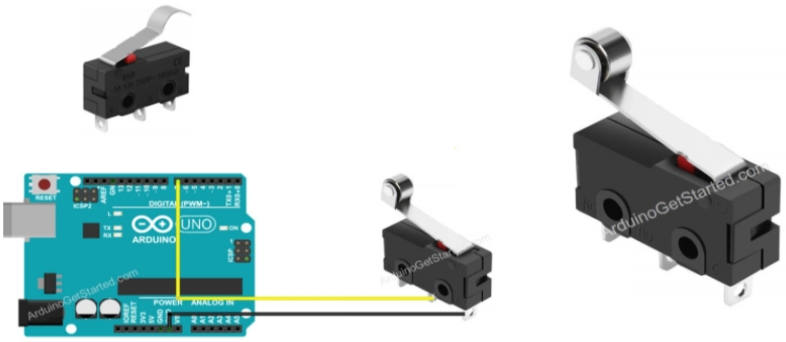
16X2 LCD display with blue backlight equipped with an I2C converter.

After soldering the serial converter behind the screen, the following connections were made with ARDUINO ONE:



- **MICROSWITCH**

The microswitch is a mechanical component for disabling and locking the motor. In this case, a



three-pin microswitch was used, but only two pins were connected, one pin to GND and one pin to a digital pin on the Arduino uno.
It's quite common to use only 2 of the 3 switch terminals, depending on how you want it to function. In most applications, you'll probably use the Common and Normally Open terminals.
C = Common.
NO = Normally Open. There is no connection "normally" (when the button/lever is not pushed). When you push the button, NO is connected to common. (i.e. The switch is OFF 'till you push the button.... This is probably how you expect a "regular" pushbutton switch to work.)
NC = Normally Closed. When the button is not pushed, NC is connected to C. (i.e. The switch is ON.) When you push the button, the switch turns OFF and there is no connection to NC.
There is NEVER a connection between NC and NO unless you make an external connection for some reason. (There are special "make before break" switches that connect all three terminals while being switched, but they are very rare and we'll leave that for later).

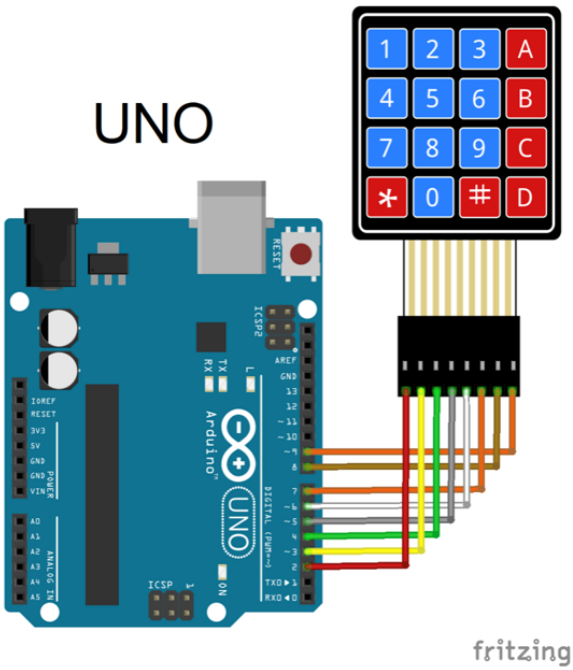
- **KEYBOARD**

With 8 pins:

- A 4×4 keyboard is a 16-key keyboard consisting of a combination of four rows and four columns denoted as R1, R2, R3, R4 for rows and C1, C2, C3, C4 for columns.

- A 4×4 keypad comes with an 8-pin female connector, so it can be plugged directly to Arduino pro mini, nano or similar boards that has male header pins. Also, using an 8-pin male header it can be plugged to breadboards or boards that has suitable female headers.

The keyboard used involves 8 pins connected to the digital pins of Arduino Uno.



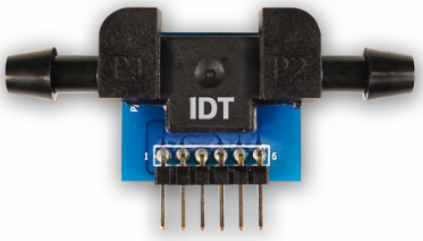
- **FLOWMETER**

Flowmeter is an instrument used to measure the flow rate of a fluid.
In the design of the infusion pump, there will be a tube at the outlet of the syringe, the flowmeter is placed around the tube, so the sensor can measure the flow rate as the fluid passes through.

Some less expensive ones involve two tubes and the interruption of the two tubes is at the sensor, inside the sensor will flow the liquid. We will use drugs that will then get to the patient so the sensor needs to be sterilized. All liquids flowing within the flowmeter must be non-corrosive

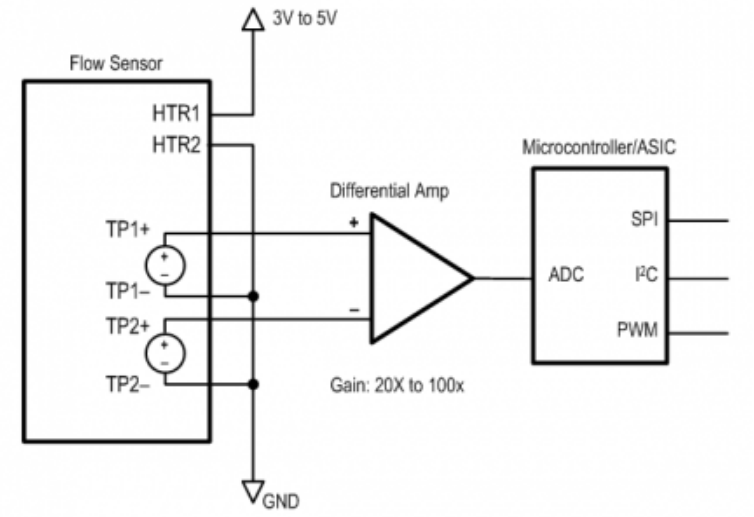
FS2012:

The FS1012 comprises a MEMS flow sensor mounted on a circuit board with a flow housing. It features a 6-pin standard header connected directly to the MEMS flow sensor.



The FS1012 is capable of measuring a non-corrosive gas or liquid medium. The sensor utilizes thermopile sensing, which provides an excellent signal-to-noise ratio and is ideal for applications requiring low power. It is highly sensitive at low flow rates with a very fast response time.

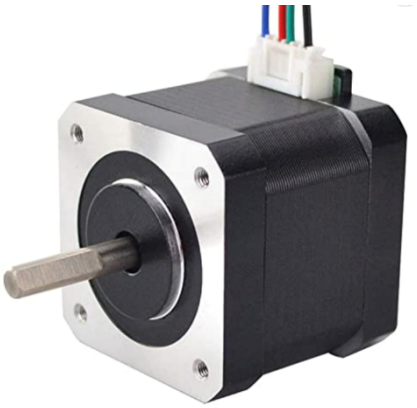
The set of upstream and downstream thermopiles can be used independently in a single-ended circuit or connected together in a differential configuration.



The flowmeter used involves 6 pins connected to the pins of Arduino Uno.

- **NEMA17**

The motor that was used for this device is the Nema 17. The Nema 17 is a permanent-magnet stepper motor, so the rotor is costituted by permanent magnets and the stator by windings wound on the polar expansions.



The rotor consists of two gears, two offset sprockets put at the ends of a magnet, so they are polarized. For the Nema17 we have such a rotor.

These motors are designed to provide the highest possible torque but minimize vibration and audible noise. It is a bipolar motor which can be turned on, off and controlled with the H-bridge (drive). If the winding is bipolar the output wires are 4.

The motor is powered by 12V. Pins 2A 2B 1A 1B are dedicated to the connection with the motor.

- DIR direction pin determines motor rotation, if it receives 0 or 1 the motor will turn in one direction rather than another

- STEP pin determines the motor advances by 1 step