



Olive oil is very appreciated however its quality varies a lot and often is distributed as EVO (extra virgin olive oil) subpar oil that isn't really eligible for that label.

EVOtest is an open-source electronic project that allows to easily test olive oil quality.

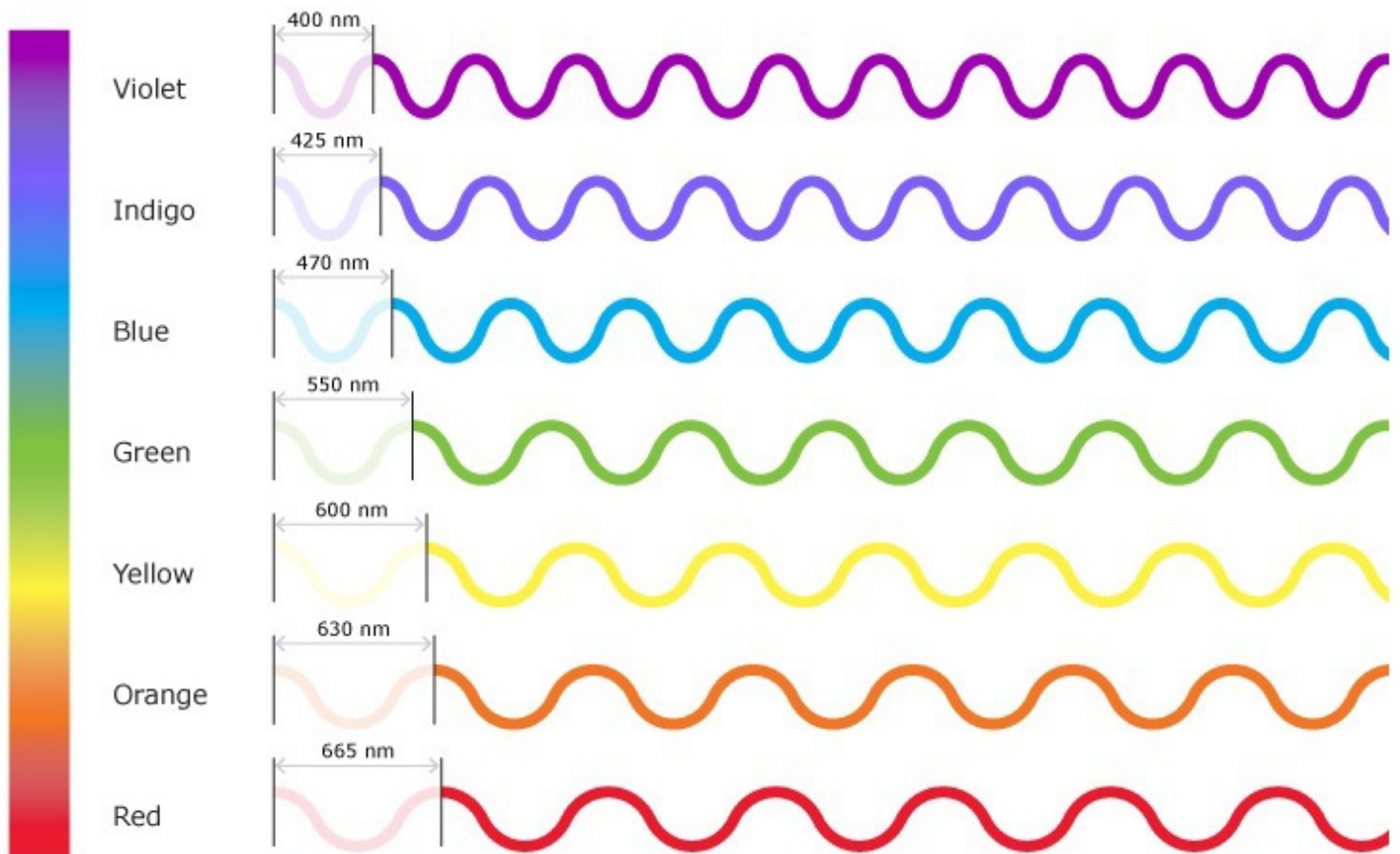
WORKING PRINCIPLE

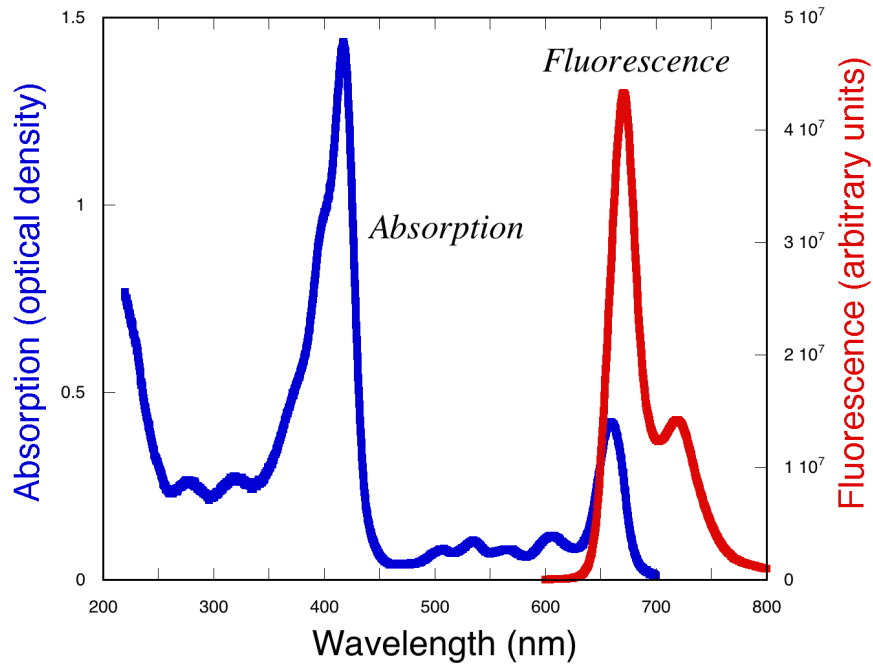
An olive oil to be label EVO must be extracted without chemical processing and at temperatures lower than 33°C or lower than 27°C (cold extraction) for the higher quality ones, and an acidity level not higher than 0.8°.

These conditions grant that oil contains chlorophyll that isn't degraded by chemical processing, high temperature heat treatments (all methods used to increase oil extraction quantity at detriment of its characteristics), so its presence gives a clue of oil quality. Chlorophyll has also interesting properties that can be used to evaluate its presence and/or integrity.

EVOtest uses a laser diode with wavelength in 405nm-445nm range to check absorbance properties of chlorophyll and elicit its fluorescence and a sensor to analyze color spectrum, considering that chlorophyll fluorescence emission peaks around 680nm-700nm (red light spectrum) wavelength and chlorophyll absorbance peaks around 400nm-450nm wavelength.

LIGHT SPECTRUM WAVELENGTHS/COLORS





**CHLOROPHYL
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 PROPERTIES**
[Photosynthesis Lab Manual \(BIOL 4160\)](#)

It is also important to note that this test cannot directly measure the oil acidity, however if the oil has high acidity level the chlorophyll will degrade faster over the time.

The test is also able to determine if the oil tested isn't olive oil at all, considering that in vegetable oils except olive oil there is a strong fluorescence emission around 430nm-470nm (between indigo and blue light spectrum).

In the table below we can see the sensor RGB channels values of some specimen.

Type	R	G	B
Extra virgin olive oil	85	11	20
Bad quality olive oil	75	15	70
Seed oil	30	60	150

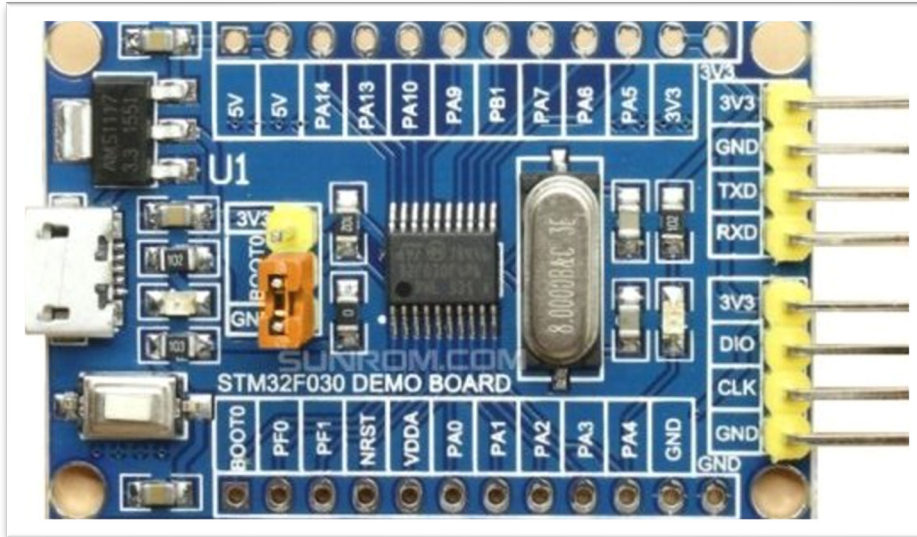
THE DEVICE

EVOTest consists of a small device powered through *microUSB* port so that could be powered with common *microUSB* chargers.

COMPONENTS

Here the list of the components used for the prototype

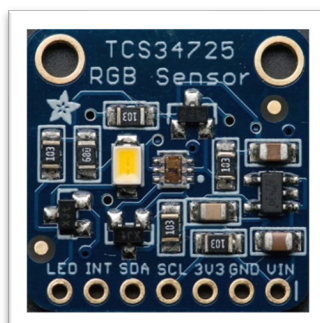
- *STM32F030F4 Demo Board*, an *STM32* MCU with a *Cortex-M0* 48MHz, 4KB SRAM, 16KB flash storage. It has been chosen because it is an inexpensive microcontroller unit easily available and it's enough to meet this project requirements, however nothing prevents you to use something better.



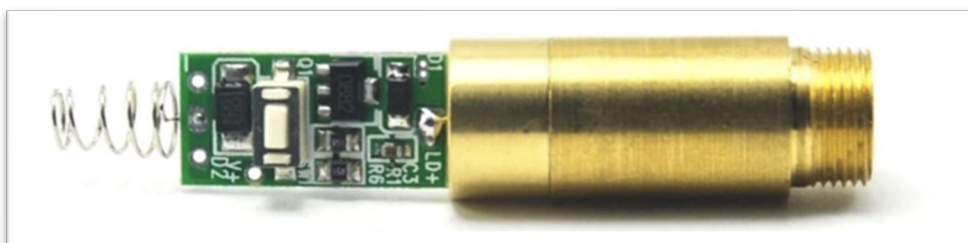
- 0.91" *SSD1306 OLED* Display (they are available in 2 versions: white active pixel and blue\yellow active pixels, choosing one version or another doesn't make any difference).



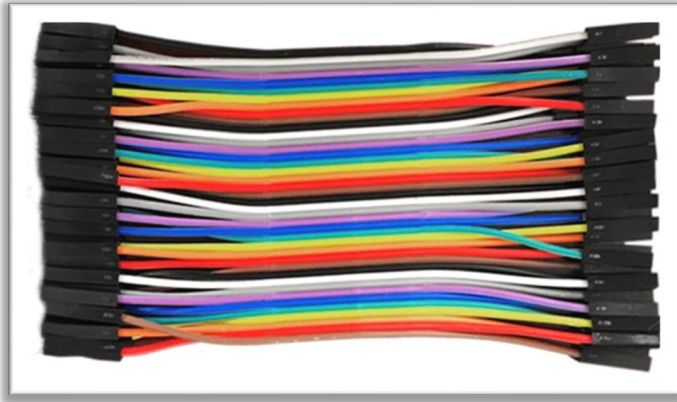
- *TCS34725* color sensor based on a photodiode array, with each photodiode filtered to be sensitive to different light spectrum except one that is unfiltered, in order to output *RGBC* (red, green, blue, clear) values, the sensing part is located at the center, it has also a LED that can be controlled with *LED* pin (for our analysis it is switched off).



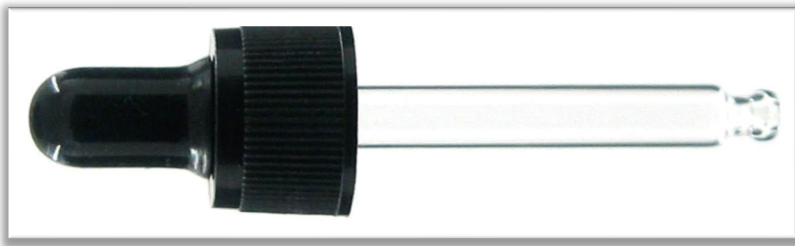
- 405nm laser module, <5mW power (typically used for purple laser pointer pens).



- F-F *DuPont* connectors (not needed if as alternative you sold wires and don't want to have an easy access to SWD programming pins).

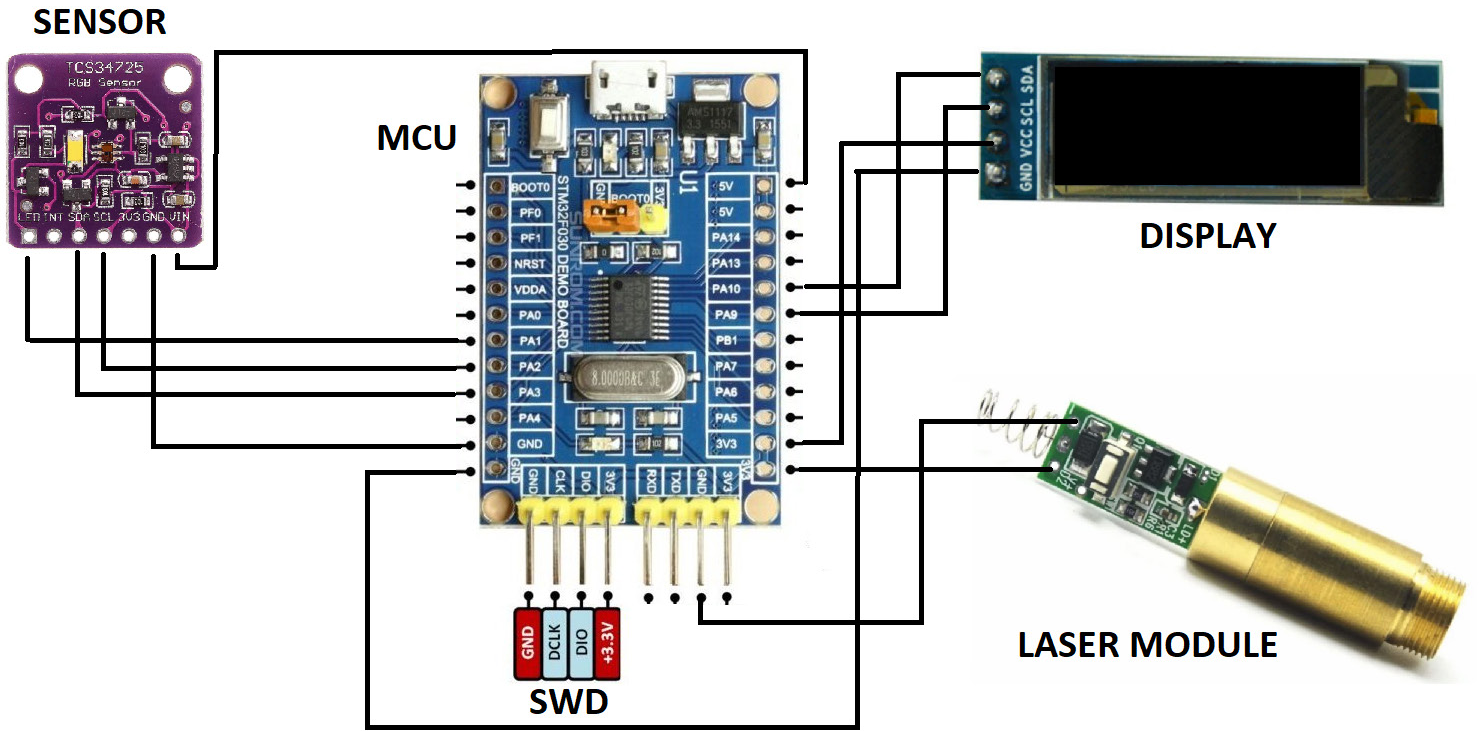


- Transparent glass pipette 7mm diameter, 50mm length.



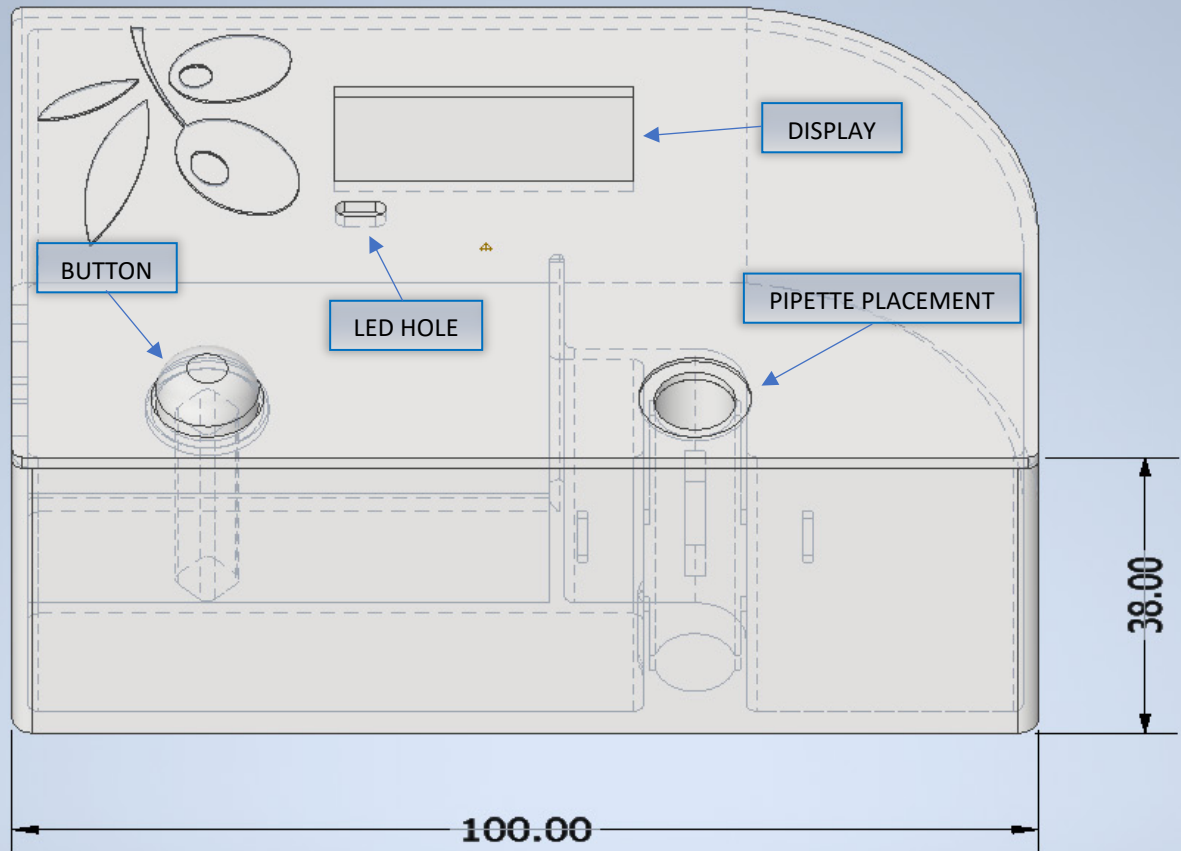
- Hot glue to keep the parts in place.
- 50g PLA to 3D print all case parts using STL files provided.

WIRING



3D MODEL

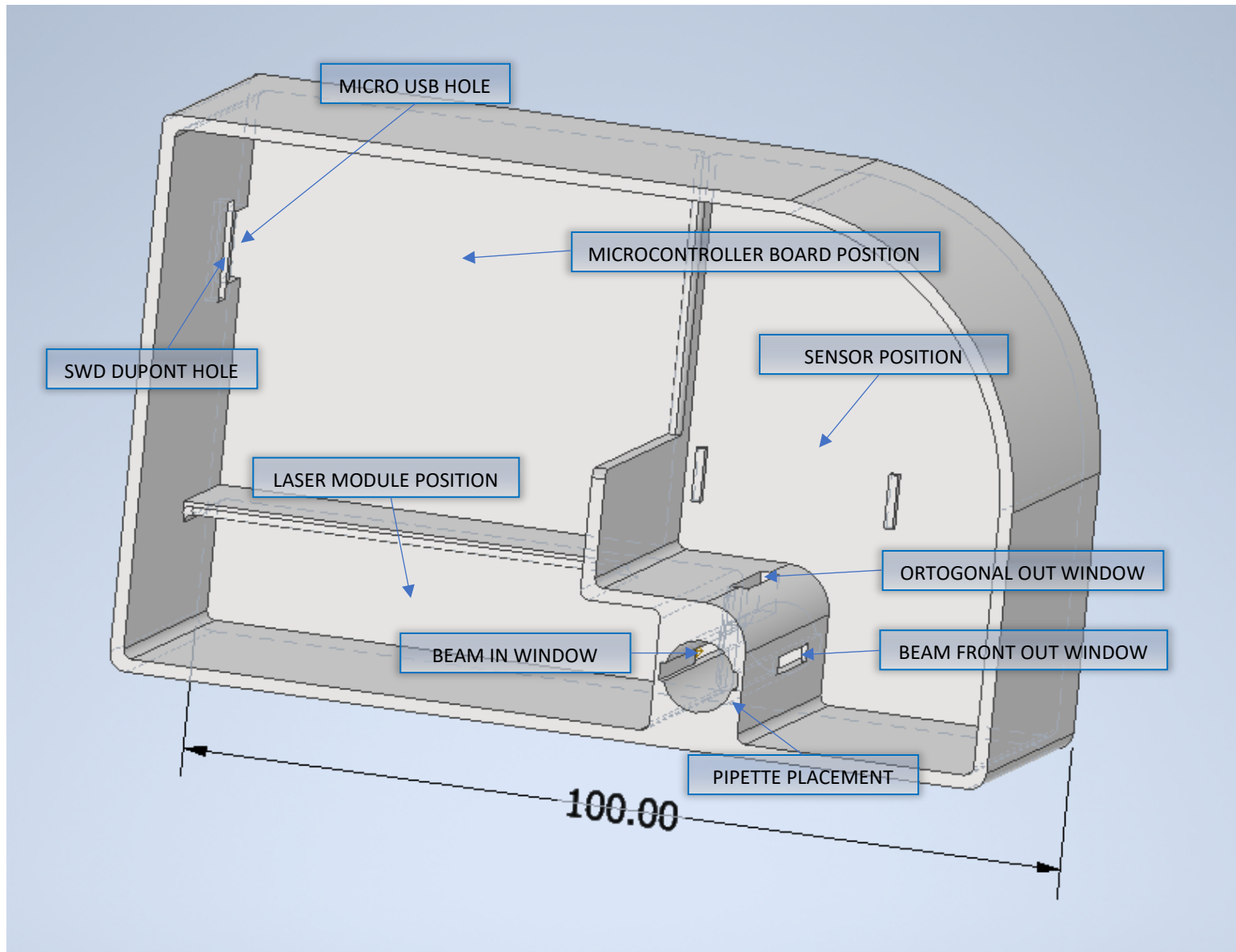
EXTERNAL VIEW



The device has just one button on upper side.

The LED hole allows you to see the light emitted from the LED on the MCU board that indicates the working status and will blink when emission is detected by the sensor during the analysis of the sample.

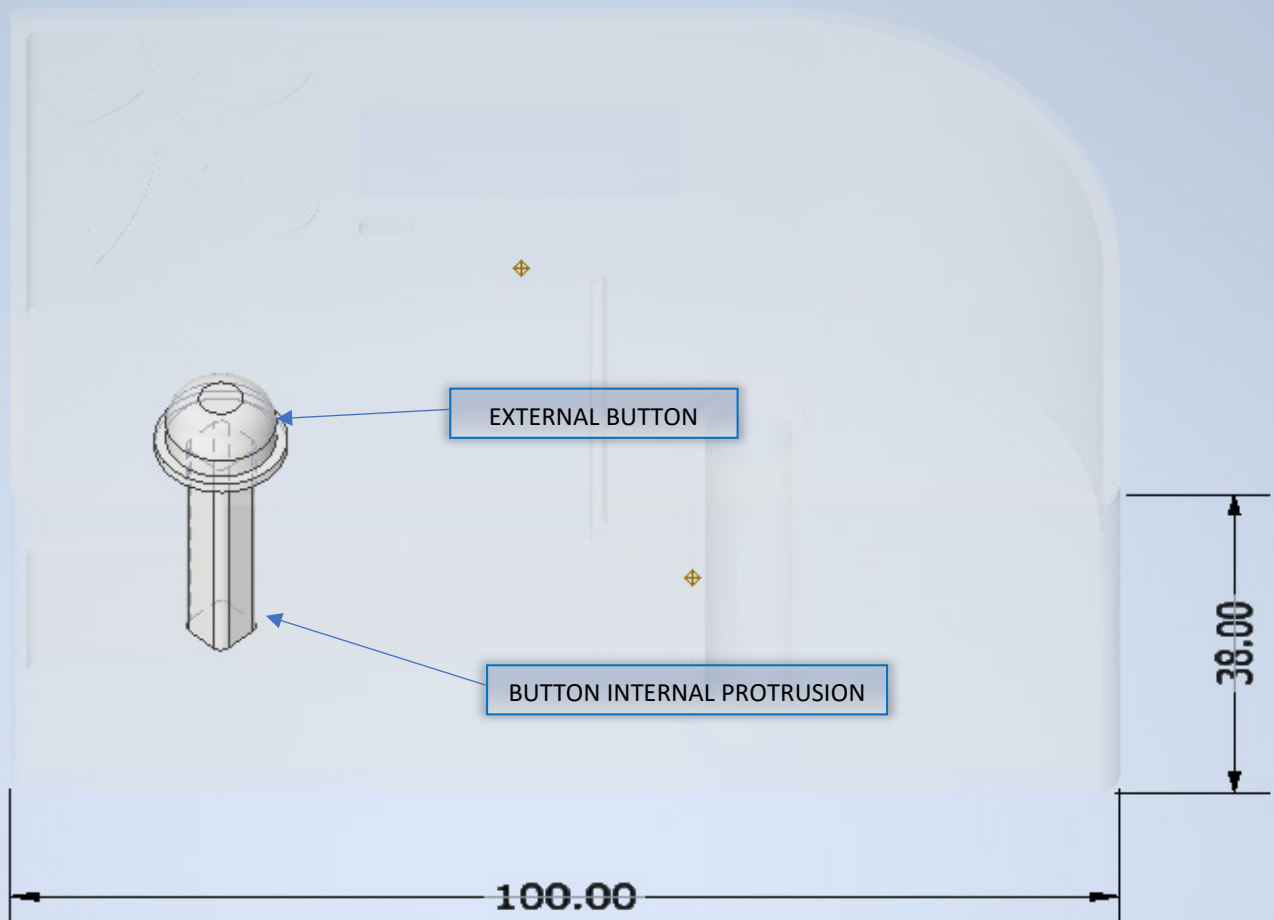
INTERNAL VIEW



The internal area has 3 sections where you must pay attention to place the various components, making sure that no other light other than the one emitted by the out window of pipette placement could be detected by sensor.

“SWD *DuPont* hole” is just in order to make the SWD programmer interface accessible from outside without the need to detach the top, in case you want to update the firmware after device assembly; this is realized attaching 4 F-F *DuPont* jumpers to the board SWD pins and fix them with a bit of hot glue the other end over that hole so that we have an external programmer port. If you are not interested in this feature, you could simply close it.

BUTTON VIEW



The external button has a protrusion to reach the momentary switch on laser driver board, so when the external button is clicked the laser beam is emitted.

ANALYSIS STEPS

- 1) Use the pipette to pick an oil sample;
- 2) Place the pipette with the oil in *EVOTest* Pipette Placement paying attention to not squeeze it, the oil must remain in the pipette;
- 3) Click the button to start the analysis, that must be clicked only when the pipette with oil sample is placed in pipette placement.

When the button is pressed the laser pass through the oil in the pipette and fluorescence light emitted by the window orthogonal to the laser beam line hits the sensor. When the sensor is illuminated, the firmware in the microcontroller starts to accumulate various read of the color spectrum, and when the button is released, it calculates the average values for RGB channels, passing the values to the algorithms that calculates the score and finally show the results on the display.

NOTES

- The project model and firmware code are just preliminary concept versions that could be improved refining the current analysis method and adding additional modules and test routines to evaluate other aspects.
- Direct soldering of the wires without using DuPont jumpers and headers would have allowed a much more compact version of the device to be designed by eliminating the need for sufficient space for the terminals and connector headers, but this would also have made modification more difficult.
- This code has been optimized for the use with *STM32F030F4P6* and has been tested on *STM32F030F4 Demo Board*, in order to fit in small flash of this board (just 16KB) the default USART serial support must be disabled.
- This code uses customized libraries for sensor and display, so they aren't available in standard repositories. Use the libraries provided e.g., copying them from libs folder to your Arduino\libraries folder (or configuring them properly for whatever IDE you use).
- Use low power <5mW laser diodes (as the one used for pointers), do not use high power lasers.
- Laser modules even at same wavelength and power level may have different lens configuration and collimation, so you may need to do some calibration to get consistent results with different laser modules.
- The stereolithographic files STL in 3D models libraries can be easily printed with common FDM 3D printer and filaments, however make sure to avoid to use transparent materials that could make filter external light in analysis chamber, this is very important. (I have used black PLA to print my prototype.)

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