DESIGNING AND IMPLEMENTING AN EXPERIMENTAL MODEL SYSTEM FOR CAPTURING AND PROCESSING IMAGES OF CEREAL CROPS

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SUMMARY: This document will present a concept for processing images of cereal crops, starting from the confirmation of temperature and humidity, using a temperature and humidity measuring stand, to the lifting of a drone that takes pictures and the software that analyzes the images and transmits data to us, obtaining important information about the crops themselves in the end.

KEY WORDS: drone, grain crop

1. Introduction

The study investigates the difference in the shade of cereal crops at different stages of the season, depending on the current weather conditions. Using a drone, the crops are photographed, then the differences are identified using image analysis software. Before the drone is lifted, a temperature and humidity measuring stand is used to decide whether the drone can fly.

The temperature and humidity stand has a stable, weather-resistant design with a removable foot that can be adjusted to the height required. The stand can display temperature and humidity on a display on the stand's leg or transmit information using radio waves to the laptop.

The pictures are taken with a drone, specifically a DJI TELLO drone, which has a 5MP camera on the front.

The pictures are processed with the help of the software “NI Vision Assistant”, where after a complex colour analysis we can reach different conclusions regarding the degree of development or yellowing of the crops.

Fig.1 - DJI TELLO drone

Fig. 2 – Picture from the software “NI Vision Assistant”

Fig. 3 - Temperature and humidity measuring stand

2. Current status

Many attempts and analyses are currently being made in the program to identify clear differences between the photos, with an archive of photos taken over several months, starting on 28.11.2022 when the plants were visibly sprouting and finishing the last set of photos on 20.04.2023 when the plants were almost in the flowering stage, in order to be able to analyse significant differences over the 5 months.

As a first attempt in the software, 5 functions were used to obtain data related to the images:

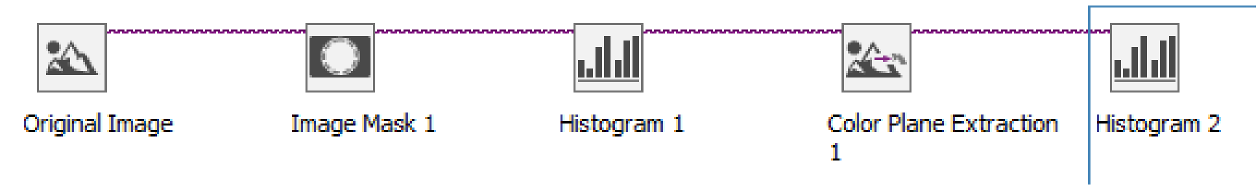


Fig.4 - Functions used in NI Vission Assistant

For each photo, a mask has been set to analyze the portion in the distance

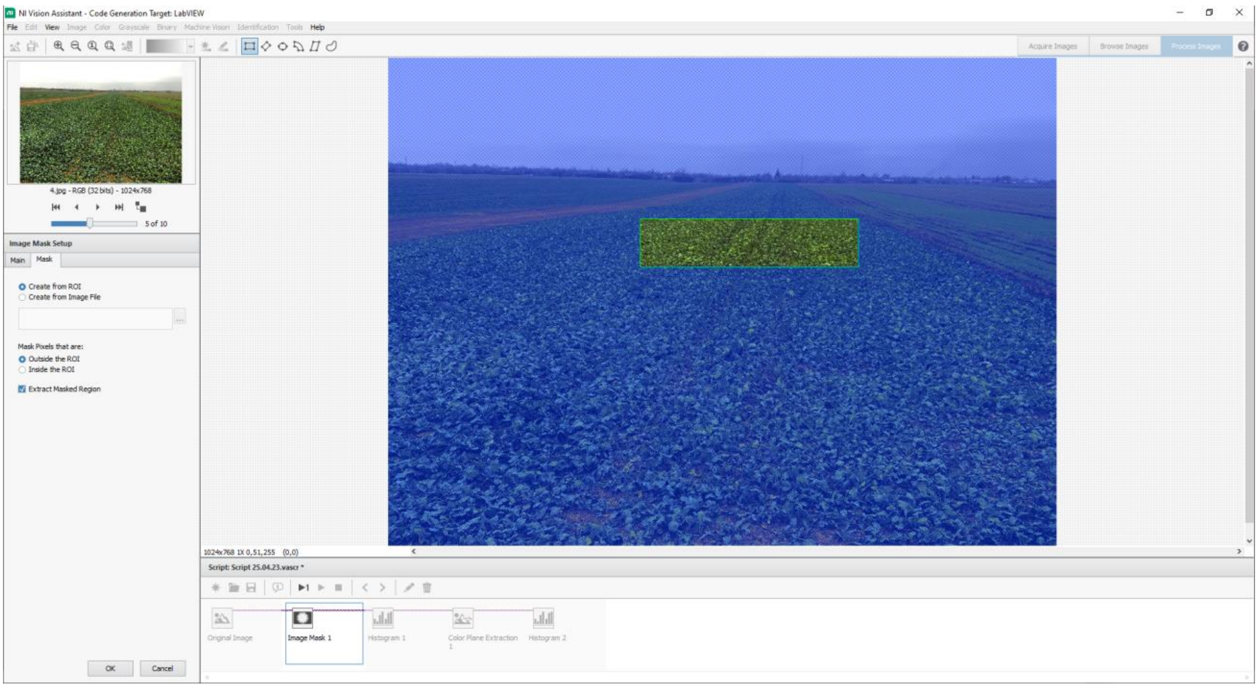


Fig. 5 - Own mask for images

At the moment, for the given script 10 photos are being analysed:

Fig. 6 - The set of photos used

After running the script on each picture is downloaded the database generated in Excel software and from there is extracted the data of interest.

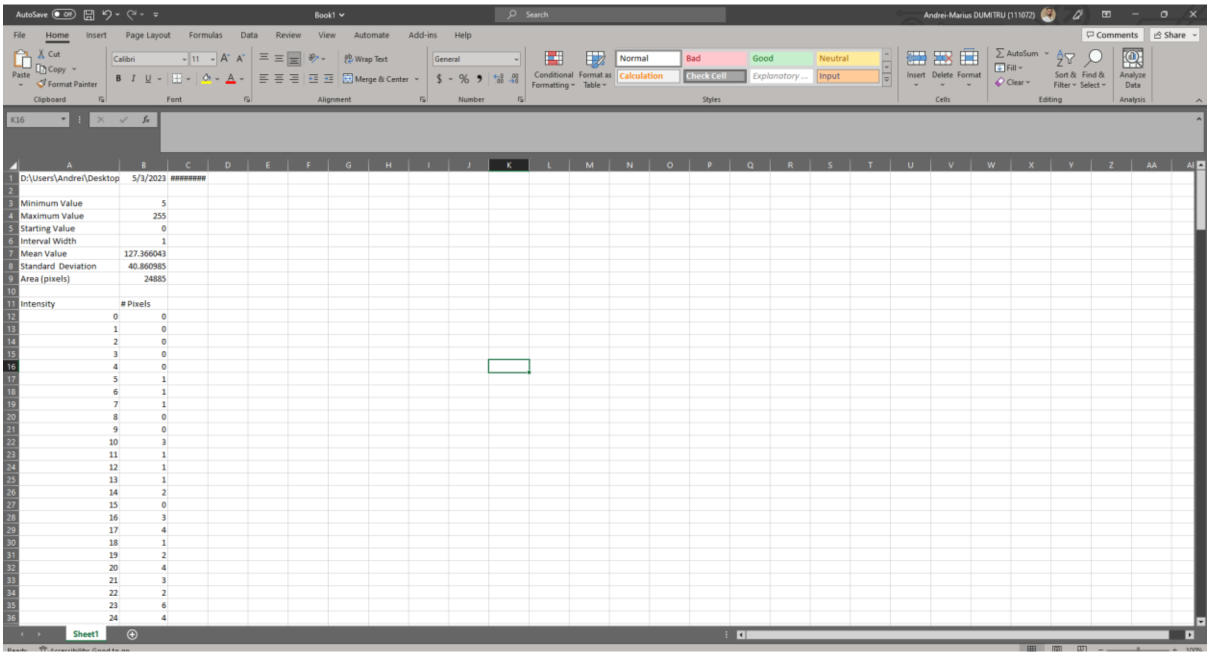


Fig. 7 - Model database received after running the program

Table with the first sets of values obtained from the first script made:

Table 1 - First values obtained

Nr. Poza	Mean Value	Standard Deviation	Area (pixels)	Maximum Value	Minimum Value
1 -28.11.2022	127.366043	40.860985	24885	255	5
2	125.971992	46.314026	24885	255	0
3	121.107384	32.123768	25675	255	11
4	93.848999	46.050266	25675	255	0
5	118.483543	46.647209	25675	255	0
6	114.18586	74.391533	25675	255	0
7	125.407631	62.221062	25675	255	0
8	123.424423	62.87529	25675	255	0
9	113.780411	52.793259	25675	255	0
10-20.04.2023	117.013985	58.184002	25675	255	0

From the above table it is proposed that after an analysis the evolution of the crop should be determined according to the humidity of the plants given by the intensity of the green colour.

The temperature and humidity measuring stand is currently fully functional, designed and programmed. Initially started from a simple schematic, then 3D designs and physical assembly.

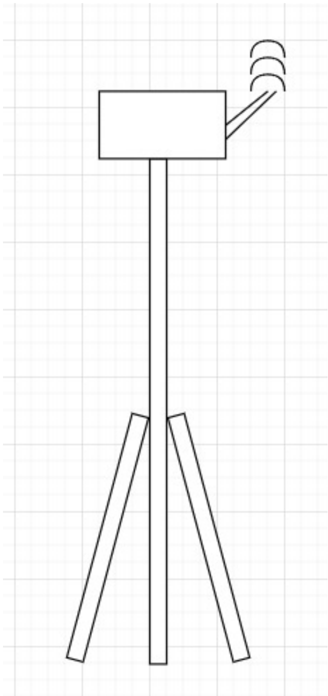


Fig.8 - Schematic of the stand

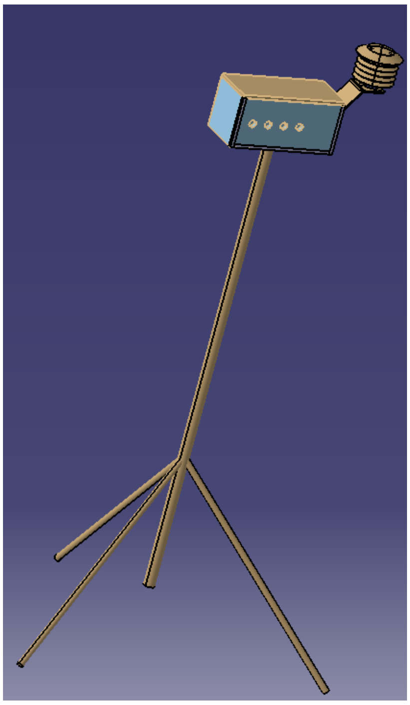


Fig.9 - 3D designed stand

Source code for stand operation and display of humidity and temperature.

File Edit Sketch Tools Help

Arduino Uno

SHT_21_LCD.ino

```
/* This code works with SHT-21/HTU-21/GY-21 Digital temperature and humidity sensor and 16x2 LCD screen
 * It displays the Temperature in Celsius and Humidity in %RH in real time
 * Refer to www.surtrtech.com for more details
 */

#include <SHT21.h>                //SHT21 and LCD i²c libraries
#include <LiquidCrystal_I2C.h>

#define I2C_ADDR 0x27 //I2C adress, you should use the code to scan the adress first (0x27) here, it may be 0x3F
#define BACKLIGHT_PIN 3 // Declaring LCD Pins
#define En_pin 2
#define Rw_pin 1
#define Rs_pin 0
#define D4_pin 4
#define D5_pin 5
#define D6_pin 6
#define D7_pin 7

SHT21 sht;                  //SHT and LCD entities
LiquidCrystal_I2C lcd(I2C_ADDR,En_pin,Rw_pin,Rs_pin,D4_pin,D5_pin,D6_pin,D7_pin);

float Temp;               //Here we store the temperature and humidity values
float Humidity;

void setup() {

  Wire.begin();
  lcd.begin (16,2);
  lcd.setBacklightPin(BACKLIGHT_PIN,POSITIVE);
  lcd.setBacklight(HIGH); //Lighting backlight
  lcd.home();

}

void loop() {

  Temp = sht.getTemperature();            //To get the temperature and humidity values and store them in their respective variable
  Humidity = sht.getHumidity();

  lcd.clear();                           //Clear the LCD and set the cursor position
  lcd.setCursor(0,0);
  lcd.print("Temp: ");                  //Print the temperature and humidity as "Temp: 23.18 C
  lcd.print(Temp);                      //                                      "Humi: 64.13 %"
  lcd.print(" C");
  lcd.setCursor(0,1);
  lcd.print("Humi: ");
  lcd.print(Humidity);
  lcd.print(" %");
  Serial.print("Temp: ");     // print readings
  Serial.print(Temp);
  Serial.print("\t Humidity: ");
  Serial.println(Humidity);

  delay(85);  // min delay for 14bit temp reading is 85ms                //You can modify or remove the delay
}

```

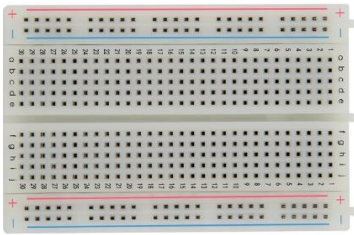
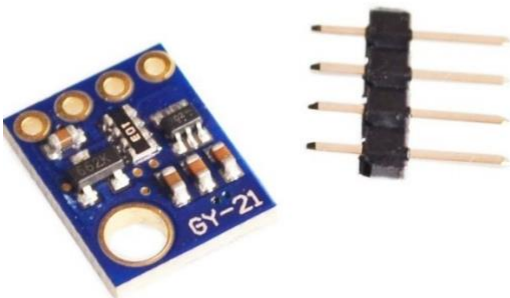
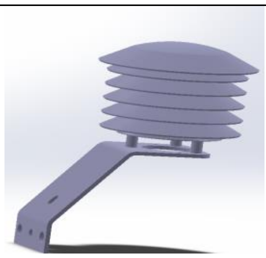
Output   Serial Monitor

Fig.10 - source code of the stand

3. Required components

The required components are:

Table 2 - Required components

NAME	IMAGE	CHARACTERISTICS
ARDUINO UNO R3 ATMEGA328P		• Operating voltage: 5V • Recommended supply voltage: 7-12V
BREADBOARD 400 PUNCTE		• Dimensions: 84 x 54.3 x 8.5 mm • Number of dots: 400
Precision Temperature and Humidity Sensor SHT21, GY-21		• Supply voltage: 2.1V - 3.6V • Low power consumption - 0.15uA • I2C interface • Weight: 1.02g • Dimensions: 21mm x 16mm
LCD Display 1602 blue + adapter i2c		• Supply voltage: 5V; • Current: 2 mA; • Backlight supply voltage: 4.2V; • Backlight current: 250mA (MAX)
Sensor protection shield		• The piece is designed in SolidWorks 2019 software, then 3D printed from PLA material.

NAME	IMAGE	CHARACTERISTICS
Metal folding tripod		• Made of metal, it offers very good stability and high durability • Maximum length 2.5m

4. Conclusions

To conclude, my personal contributions were the creation of an experimental script for image analysis, design and programming of the temperature and humidity stand, and after several tests in NI Vision Assistant to find the optimal variant of crop analysis.

5. Bibliography

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