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UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Workshop SeSAM: Sensing Systems for Agricultural Management

Development of a Low-Cost Optical System for Monitoring Plastics in Irrigation System Grids

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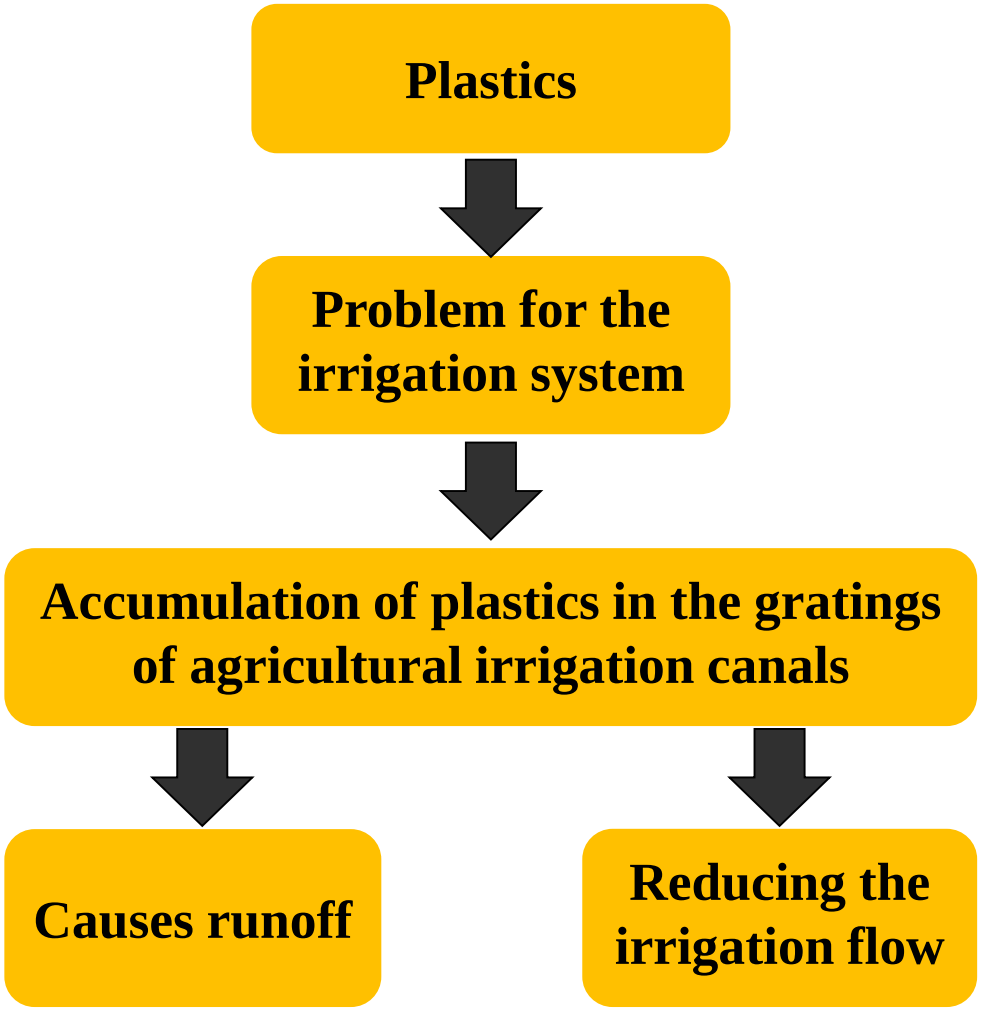
INTRODUCTION

INTRODUCTION



INTRODUCTION

Commonly used method → **Satellite method**

We propose → **Sensor for detecting the presence of plastics in the irrigation grids** → **Plastic bags**, **Bottles**, **Other plastic waste**

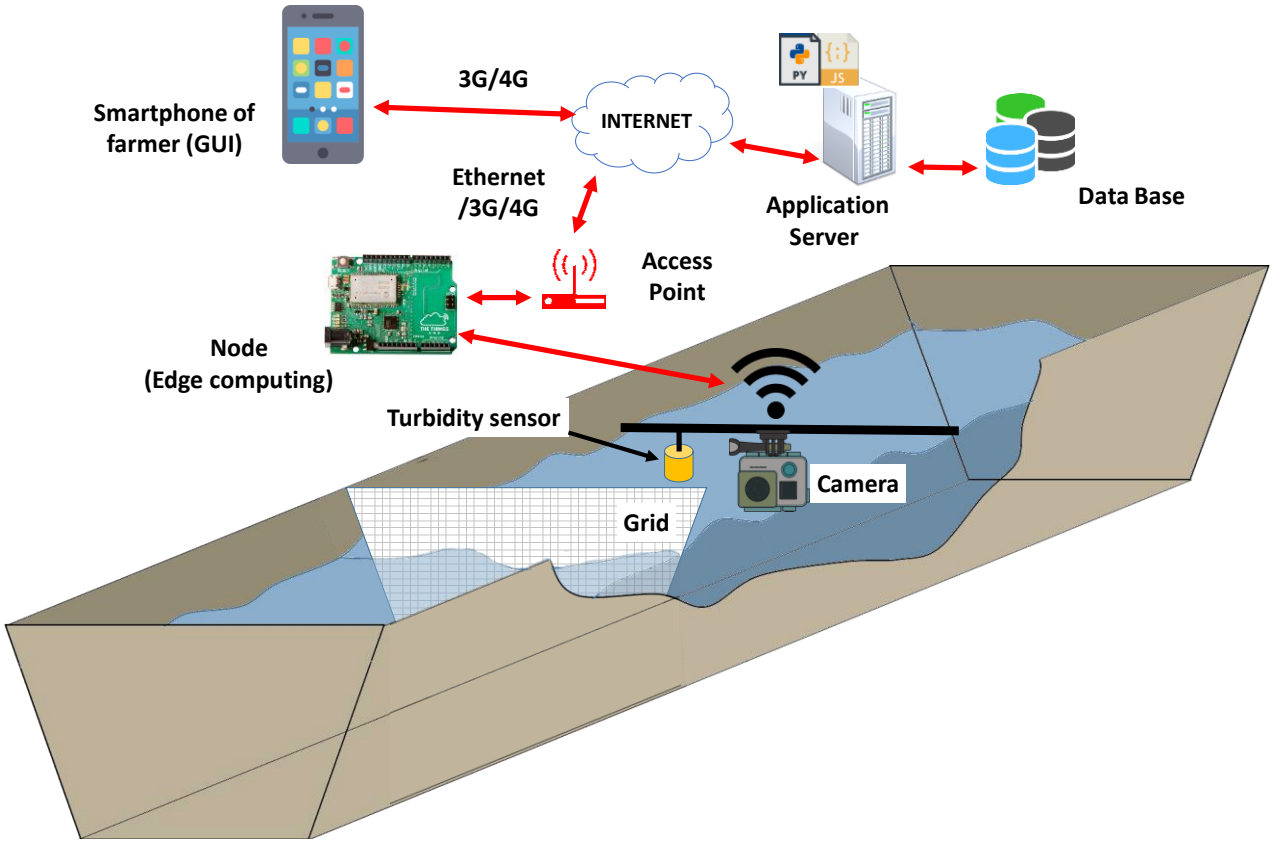
RELATED WORK

RELATED WORK

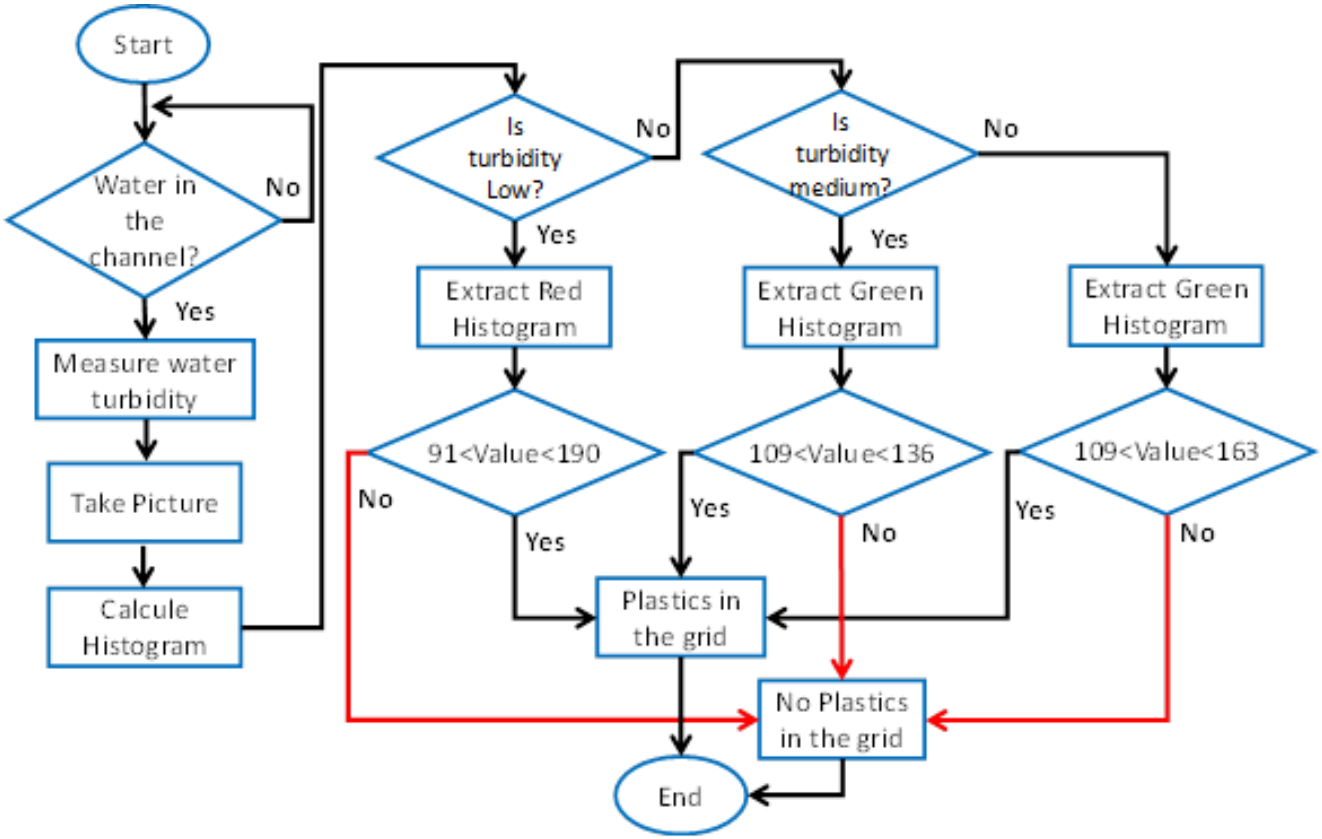
DETECT PLASTICS IN THE OCEAN	• *Using equipment mounted on a c-130 aircraft, which captured swir red, green, and blue (RGB) and hyperspectral images.* ***Karaba et al.***
DETECTION OF MACROPLASTICS	• *Using the sentinel-2 satellites of the European Space Agency (ESA)* ***Biermann et al.***
OPTICAL SYSTEM CAPABLE OF DETECTING MICROPLASTICS IN WATER	• *Developed sensor is based on a low-cost system based on a spectrophotometer* ***Iri et al.***
METHOD FOR THE DETECTION OF PLASTICS	• *This system is based on an automated system monitoring that detects said contamination* ***Van Lieshout et al.***

PROPOSAL

PROPOSAL


Smartphone of farmer (GUI)
3G/4G
INTERNET
Ethernet /3G/4G
Application Server
Data Base
Access Point
Node (Edge computing)
Turbidity sensor
Camera
Grid

PROPOSAL


Start
Water in the channel?
No
Yes
Measure water turbidity
Take Picture
Calcule Histogram
Is turbidity Low?
No
Yes
Extract Red Histogram
91<Value<190
No
Yes
Is turbidity medium?
No
Yes
Extract Green Histogram
109<Value<136
Yes
No
Extract Green Histogram
109<Value<163
Yes
No
Plastics in the grid
No Plastics in the grid
End

TEST BENCH

TEST BENCH

- **Rectangular glass fish tank:**
  With dimensions of 24.5 cm high, 26 cm wide, and 50 cm long were used.
- **White plastic:**
  Grid 23 cm high and 25 cm wide.
- **Soil with a composition:**
  4.3 % sand, 67.3% silt, and 28.4 % clay was used as a turbidity-enhancing compound.
- **Camera**

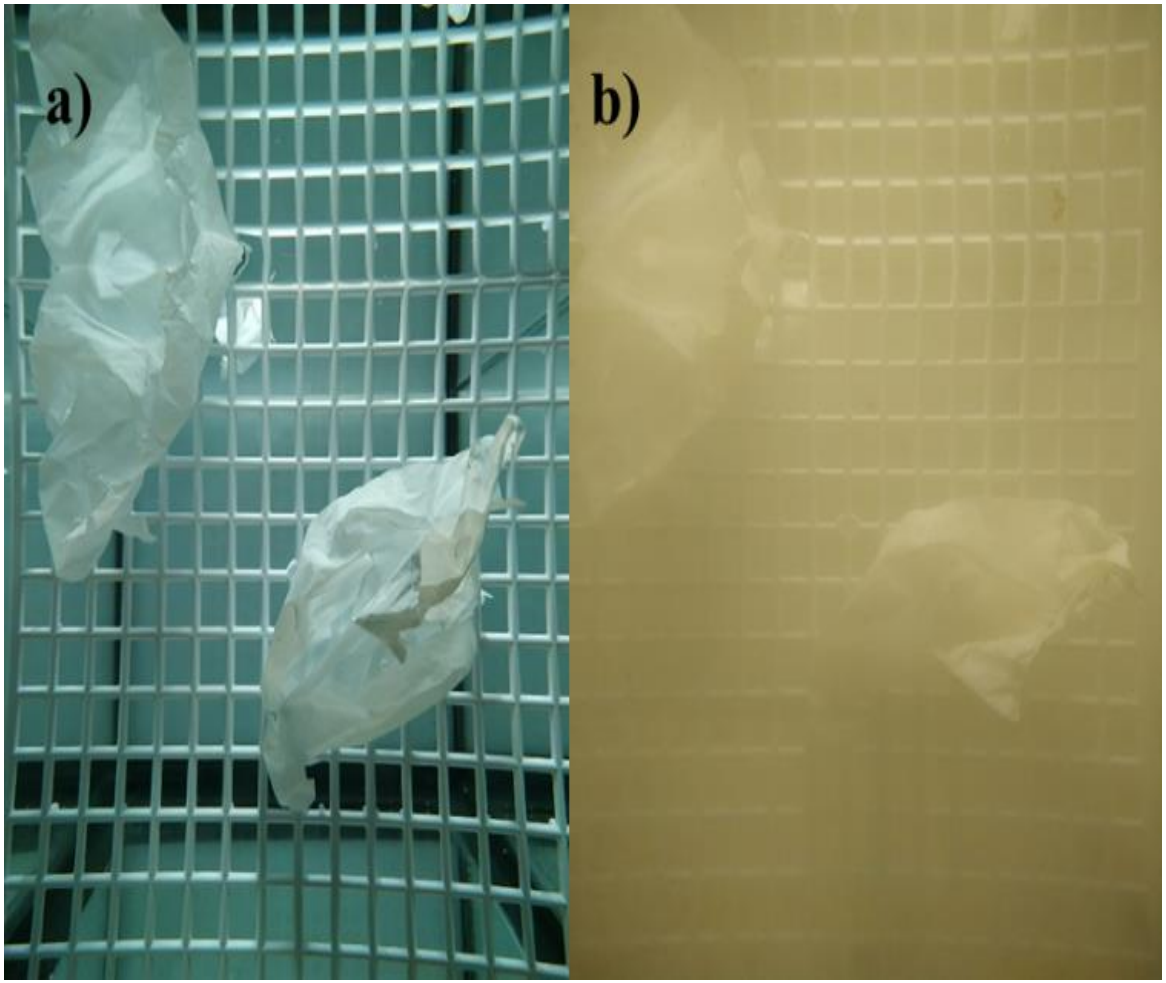
TEST BENCH

```
Function [Hist_RED, Hist_GREEN, Hist_BLUE,] = Read_Comp_Image
(Comp_RE, Comp_GR, Comp_BL, Col, Row]
//Calcule Histogram Red
Repeat
        vector_RE [i]=0    // Create_vector_RED
Up to (i=256)
Repeat
        Repeat
                Read Value= Comp_RE
                vector_RE [i]= Value
                Comp_RE++
        Up to (Column == end)
Up to (Row == end)

//Calcule Histogram Green
Repeat
        vector_GR [i]=0    // Create_vector_GREEN
Up to (i=256)
Repeat
        Repeat
                Read Value= Comp_GR
                vector_GR [i]= Value
                Comp_GR++
        Up to (Column == end)
Up to (Row == end)
```

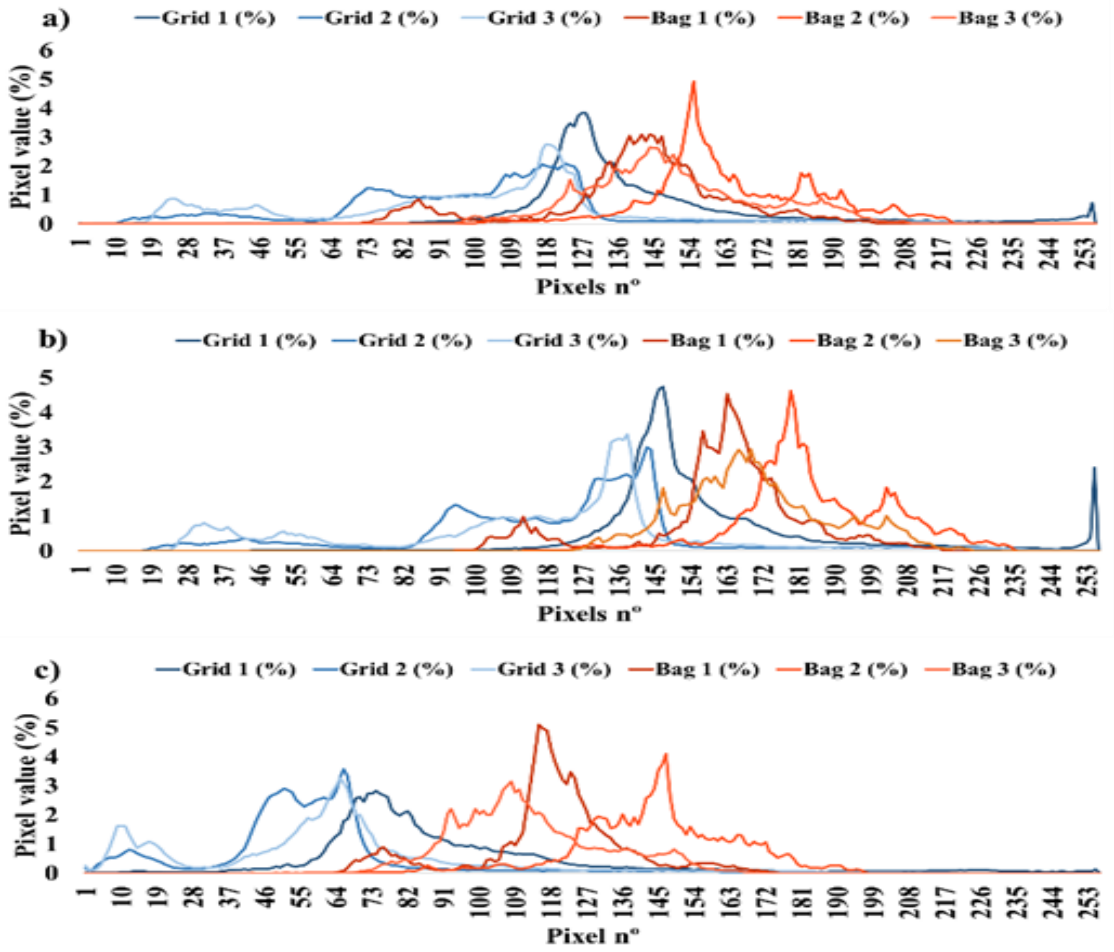
1. **The first is based on the experiment itself, where the necessary images are taken.**
2. **The second is the processing and analysis of these images in order to obtain the different histograms of these images and to be able to differentiate between the grid and the plastic bag in different conditions.**

TEST BENCH



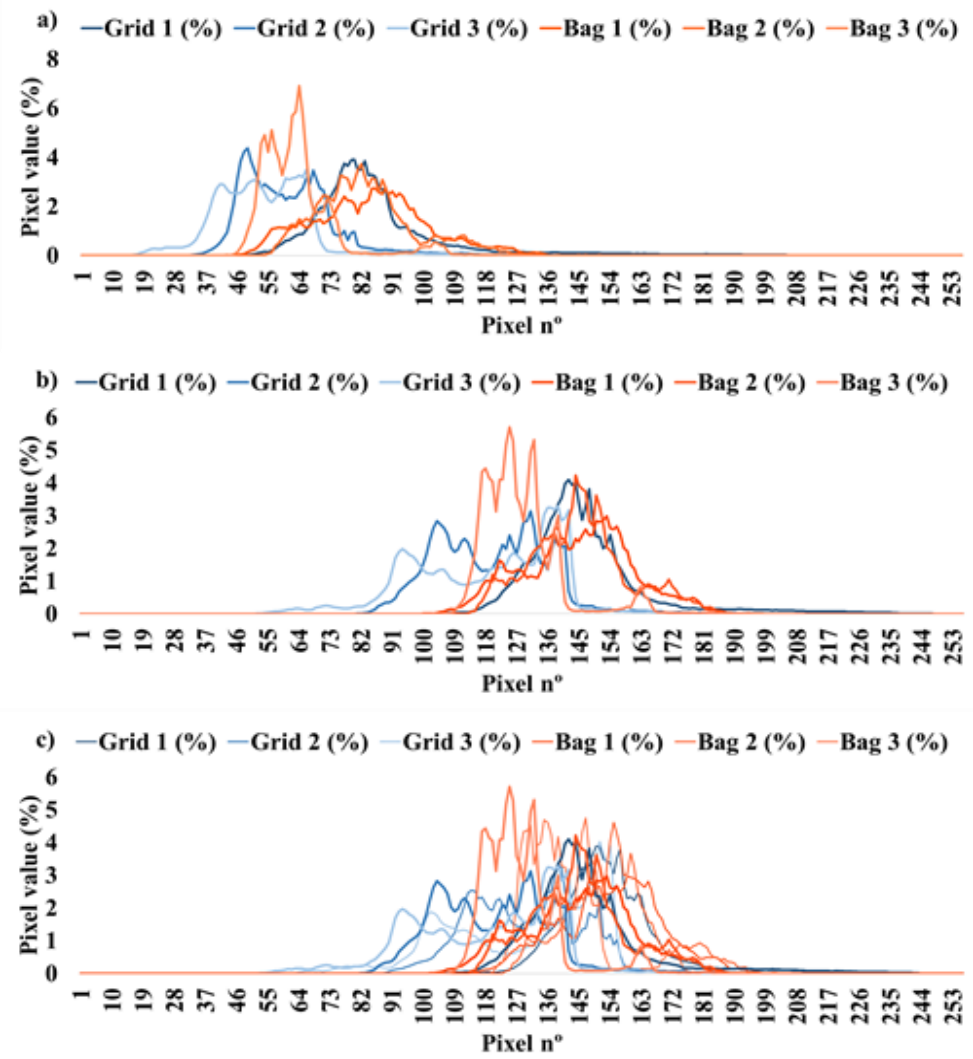
RESULTS

RESULTS



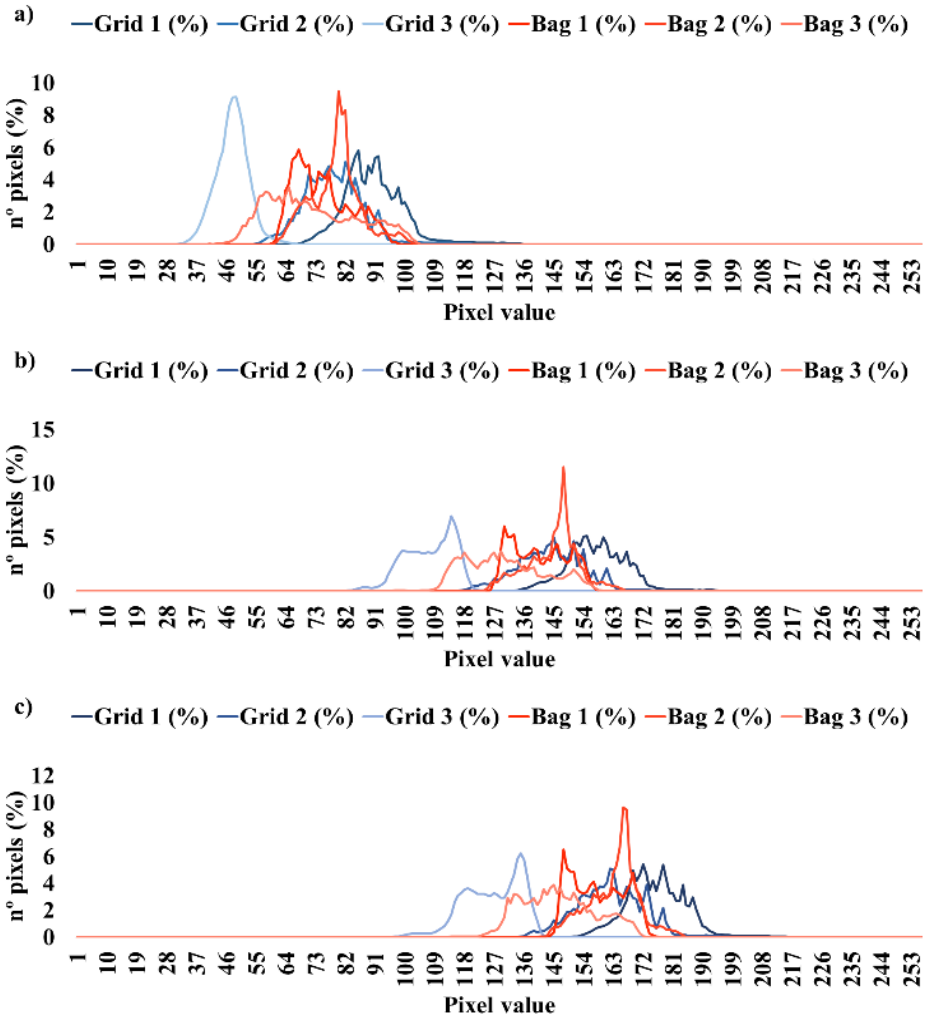
- **The most representative graph is c) where we can find the presence of grid between pixel values from 1 to 90 and from 91 to 190 for the presence of pockets.**
- **The maximum pixel percentage for grids is 4 % and 5.3 % for the bag.**

RESULTS



- **Best section is the b) with the green band. We can observe that parts of grids 2 and 3 can be distinguished from the presence of bags.**
- **The presence of the grid is located between the values 55 to 105, with a maximum pixel percentage of 3%.**
- **The results show that the system is able to differentiate some pieces of bag.**

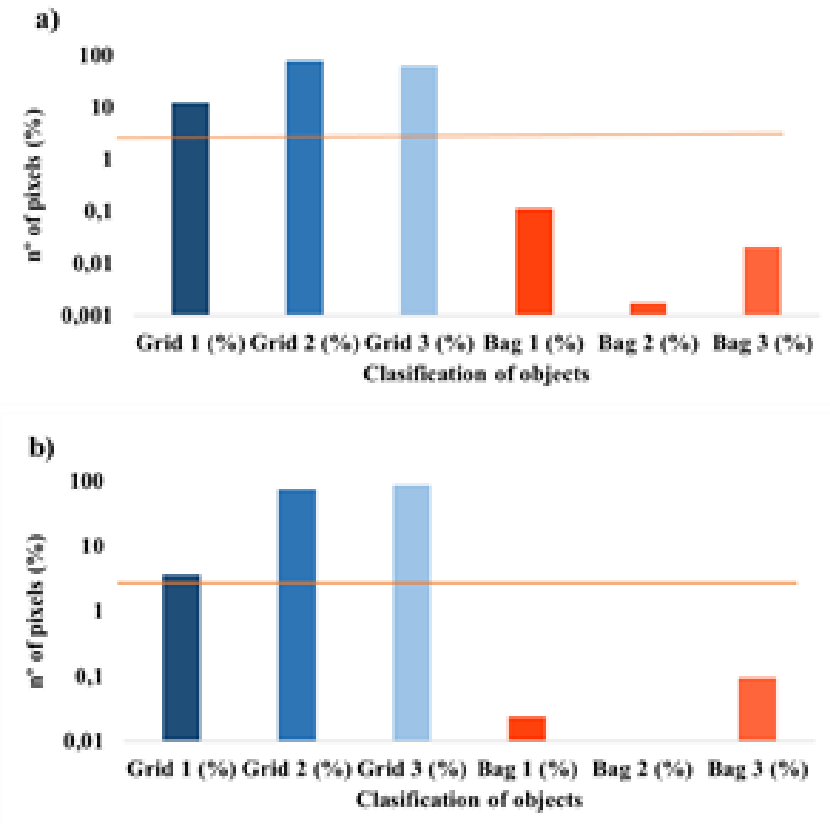
RESULTS



- **The best section is the b) with the green band.**
- **We can observe that parts of grids 2 and 3 can be distinguished from the presence of bags.**
- **The presence of the grid is located between the values 109 to 163, with a maximum pixel percentage of 12.5%.**

VERIFICATION

VERIFICATION



- **Section a) represents the values taken in the experiment.**
- **A maximum pixel % of 74.8% in grid 2, and a maximum pixel % of bags of 0.02%.**
- **Pixels above the 5% limit are considered part of the grid and below the bag. In addition.**
- **Section b) represents the verification performed, taking other different pieces of grid and bag.**
- **A maximum pixel % of 84.08% in grid 2 and a maximum pixel % of bags of 0.09%.**

CONCLUSIONS AND FUTURE WORK

CONCLUSIONS AND FUTURE WORK

- **We propose a system to monitor the presence of plastics in the gratings used in irrigation channels for agriculture.**
- **Is possible to differentiate between bags and the grid up to 5g of added soil.**
- **The proposed system is based on the application of artificial intelligence, being of great help, in this case, to be able to differentiate and learn about the presence or absence of plastics in the grid.**
- **In future work:**
  - **Test at different distances.**
  - **Extend the number of objects to be detected.**

THANK YOU FOR YOUR ATTENTION

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