

# Automatic Insect Counting using a McPhail e-Trap


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# Presentation Outline

- The Problem
- Current Practice
- Our Approach
- Automated McPhail Trap
- Automatic Insect Counting
- Web Interface
- Future Work - Challenges

# The Problem I/II

- Over 750 million olive trees are cultivated worldwide, 95% of them in the Mediterranean region.
- 93% of the European production, comes from Spain, Italy and Greece.
- Greece devotes 60% of its cultivated land to olive growing.
  - Greece is the world's top producer of black olives and has many varieties.
  - Greece holds third place in world olive production (more than 132 million trees).
  - Greece produces 350,000 tons of olive oil annually, of which 82% is extra-virgin.
- Annual national gross income, exceeds 1.6 billion Euro.

# The Problem II/II

- One of the main threats for the Olive trees and therefore for the production of the olive oil is ***Dacus - Bactrocera oleae.***
- It is considered the most serious pest towards olives in regions where it presides, significantly affecting both the amount and quality of production in most olive growing areas.
- The damages caused by the olive fruit fly are of two types***: quantitative*** and ***qualitative***.
  - From a **quantitative** point of view, the damage is caused by the removal of the significant proportion of the pulp which as a consequence results in reduction in the yield of olives. Part of the production is also lost due to premature falling of the attacked fruit.
  - A **qualitative** aspect to be considered is the significant deterioration in the quality of the oil extracted from olives with a high percentage of attacks. The oil obtained from infected olives has a high acidity level and a lower shelf life as it has a higher peroxide value.

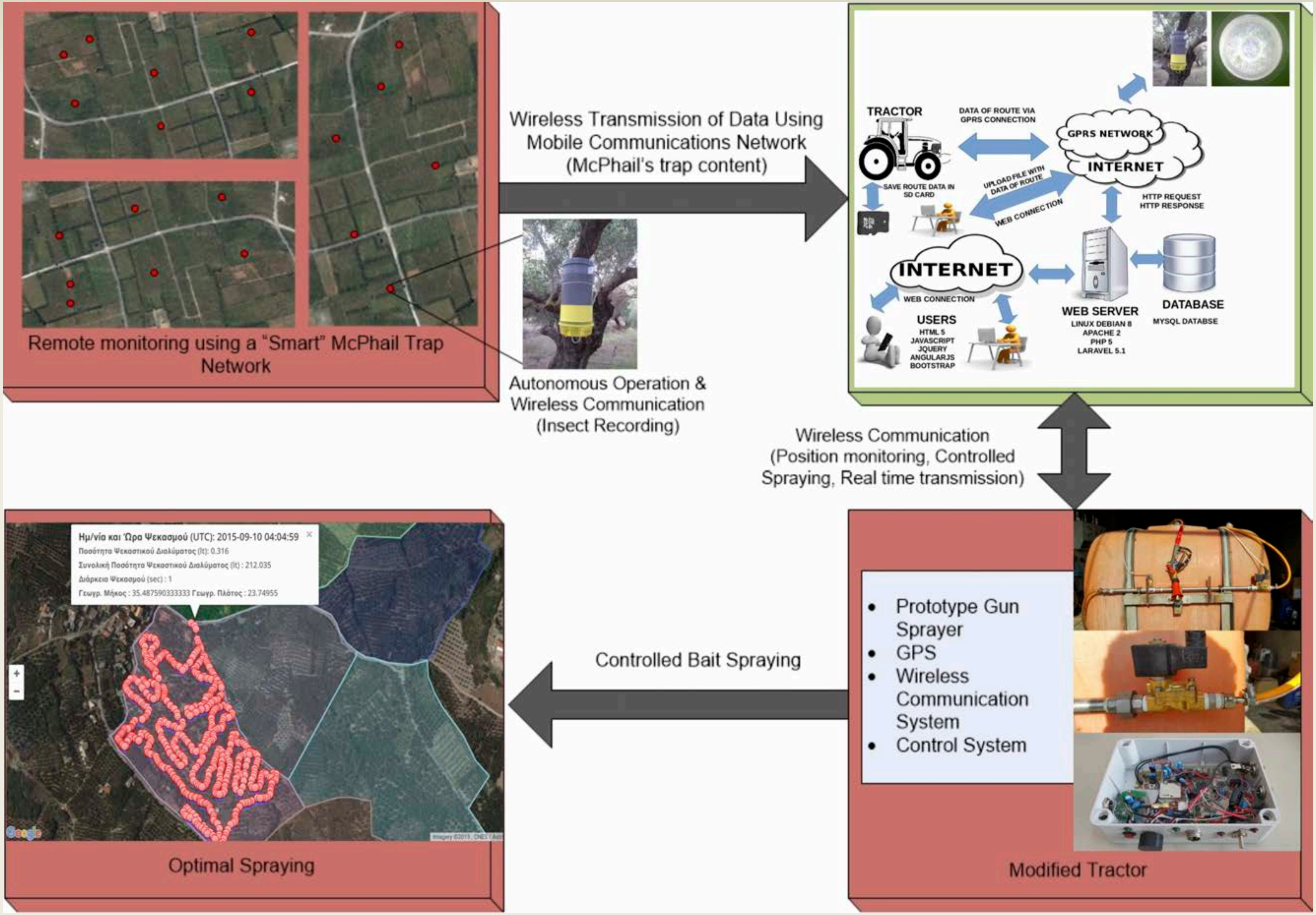
# Current Practice

- Monitoring of the Dacus population using McPhail traps.
- Creating a grid of traps in the areas of interest.
- Each trap contains a 2% of ammonium or protein solution as well as borax in order to attract the flies, it is placed within tree canopy, and the captured insects are counted every 5, 7 or 10 days. When the mean number of captured adults per trap and per week is more than 8-10, bait sprays are applied with the registered insecticide. The attractiveness of such a trap is about 20 m, but it is significantly reduced in a distance of 40 m.

**Disadvantages**

- ✓ Dependence on the procedure's efficiency on human intervention.
- ✓ Costly process (personnel, logistic aspects etc.).
- ✓ Failure to be either proactive or even in some cases to spray on time.

# Our Approach – An Integrated Pest Management System



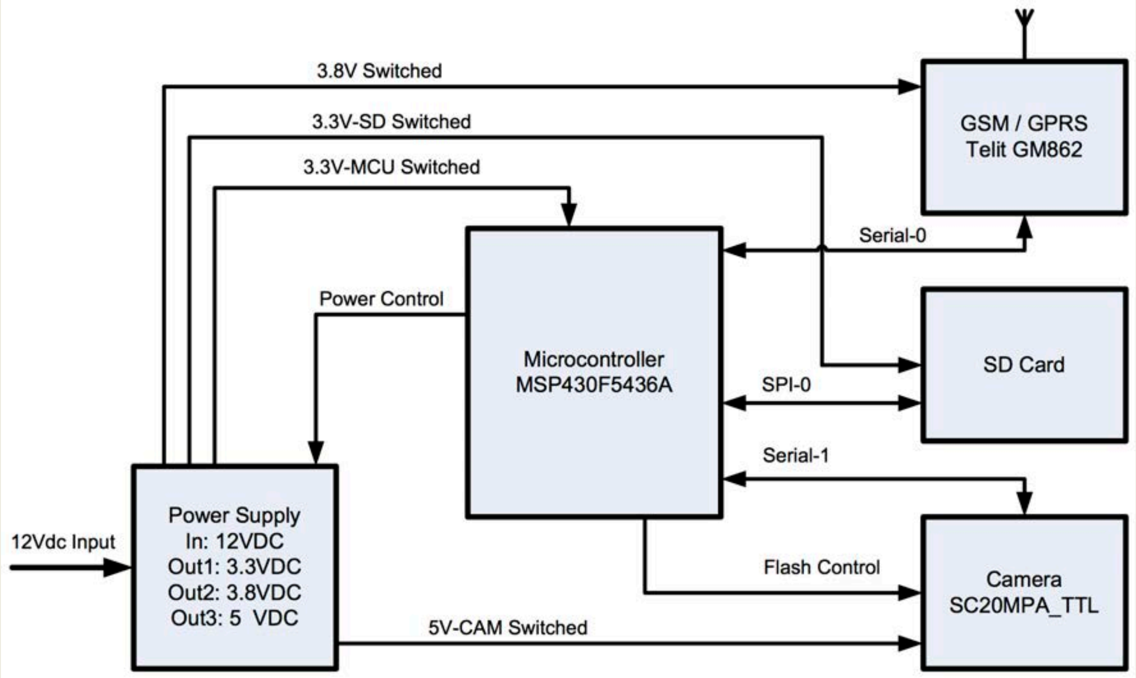
# Automated McPhail Trap

- We have developed an embedded system to **automate the monitoring process** of Dacus in the field.
- Our main considerations during the design phase where:
  - Reliability
  - Robustness
  - Accuracy
  - Low Cost
  - Endurance
- Our approach was based in three core design parameters:

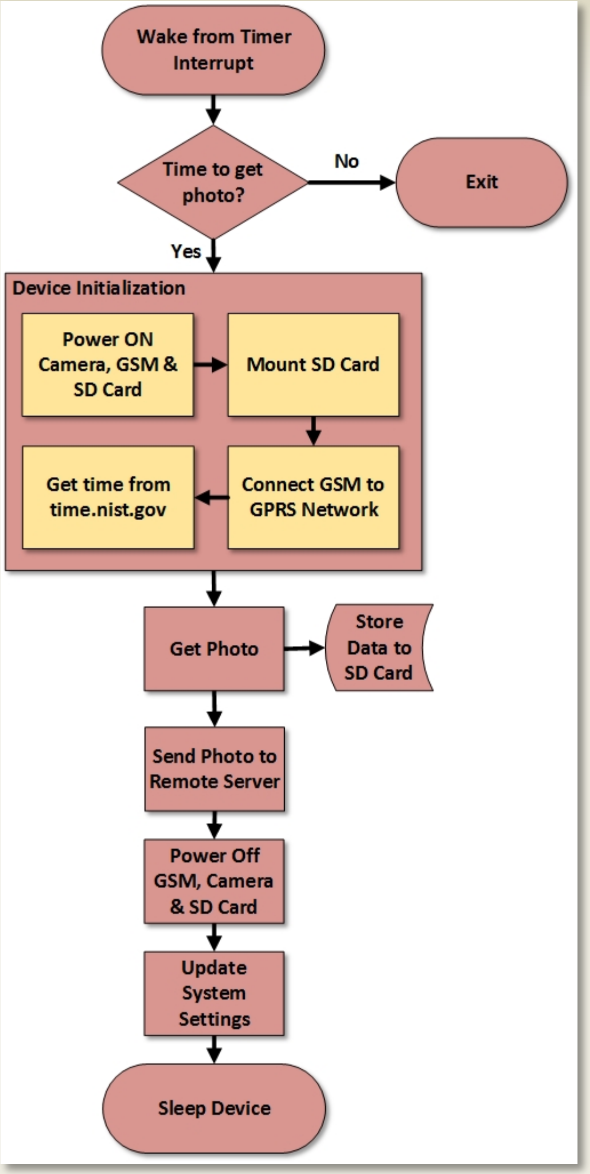
✓ Remote monitoring
✓ Wireless Communication
✓ Minimize human intervention

# Automated McPhail Trap – Core Components

1. **MSP430F5436 Microcontroller** (16-Bit Ultra-Low-Power Microcontroller, 192KB Flash, 16KB RAM, 12 Bit ADC, 4 USCIs, 32-bit)
2. **A GSM Module** GM862 TELIT with GPRS
3. **2 MP Camera**
4. **LED light array** for internal lighting
5. **3 Power supply modules** (3.3, 3.8 and 5 Volts)
6. **One battery** 12 Volts

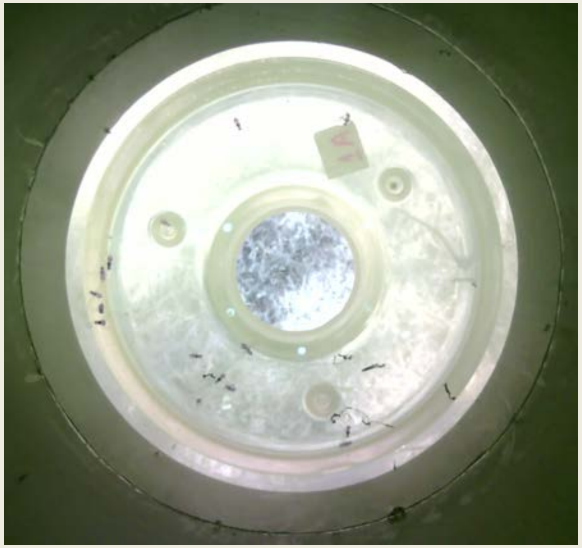



# Automated McPhail Trap – Operational Flow Chart



# Automated McPhail Trap – Preliminary Experiments

- ✓ A prototype was deployed in the field
  - ✓ Performed without problems for a long period
  - ✓ Lighting was identified as a main issue for the quality of the pictures
- ✓ A remote server was implemented in our lab and the pictures from the trap were send using the GSM network using the ftp protocol
- ✓ All registered users had access to the ftp server to evaluate the performance of the prototype



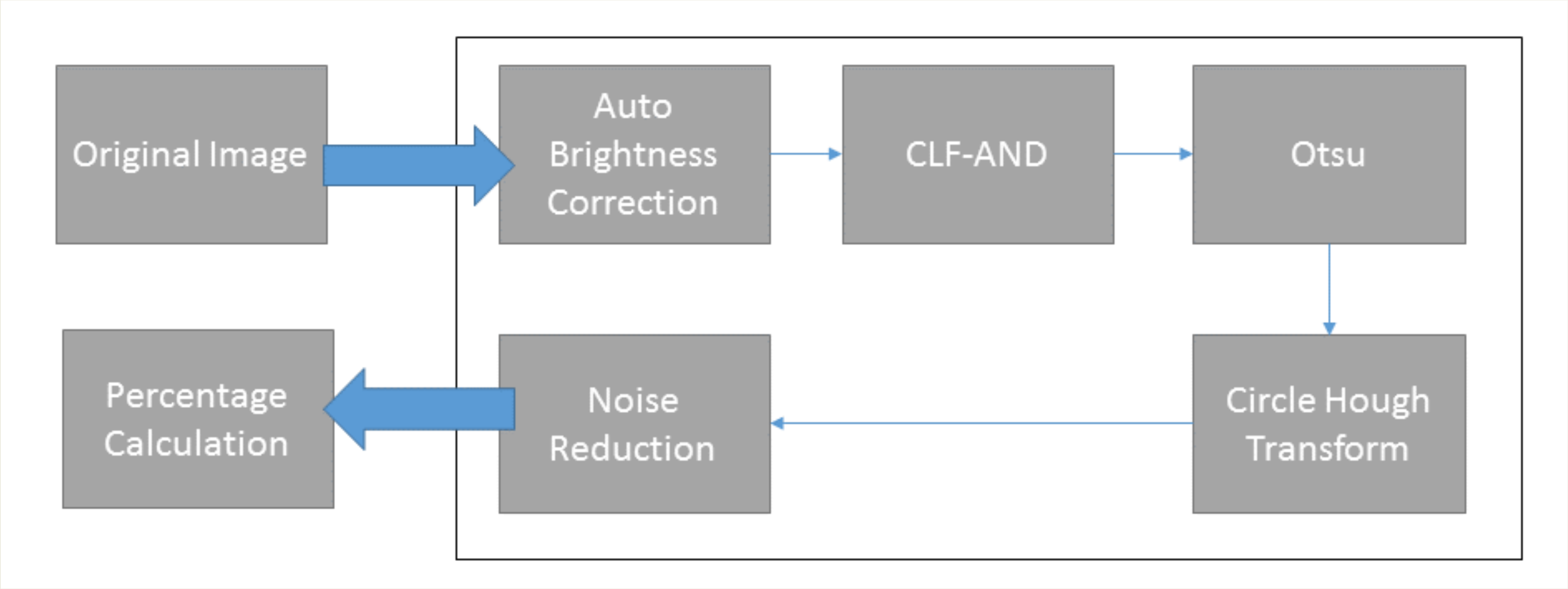
# Automatic Insect Counting

- ✓ To estimate the aggregate of the trapped olive-fruit flies, an automatically triggered light-weight web-service analyzed in real-time the captured images.
- ✓ The implementation utilizes the Java.

## High level Step-by-step procedure

- ✓ **Step 1:** A “Listener” module monitors the content of a specific folder of the server.
- ✓ **Step 2:** Once a new image is added the “Image Analyzer” as long as the “System Monitoring” component are activated.
- ✓ **Step 3:** The “Image Analyzer” performs several image processing tasks to detect and approximately measure the sum of the trapped olive-fruit flies.
- ✓ **Step 4:** The “System Monitoring” interacts with the web-interface in order to present the results of the process.

# Automatic Insect Counting



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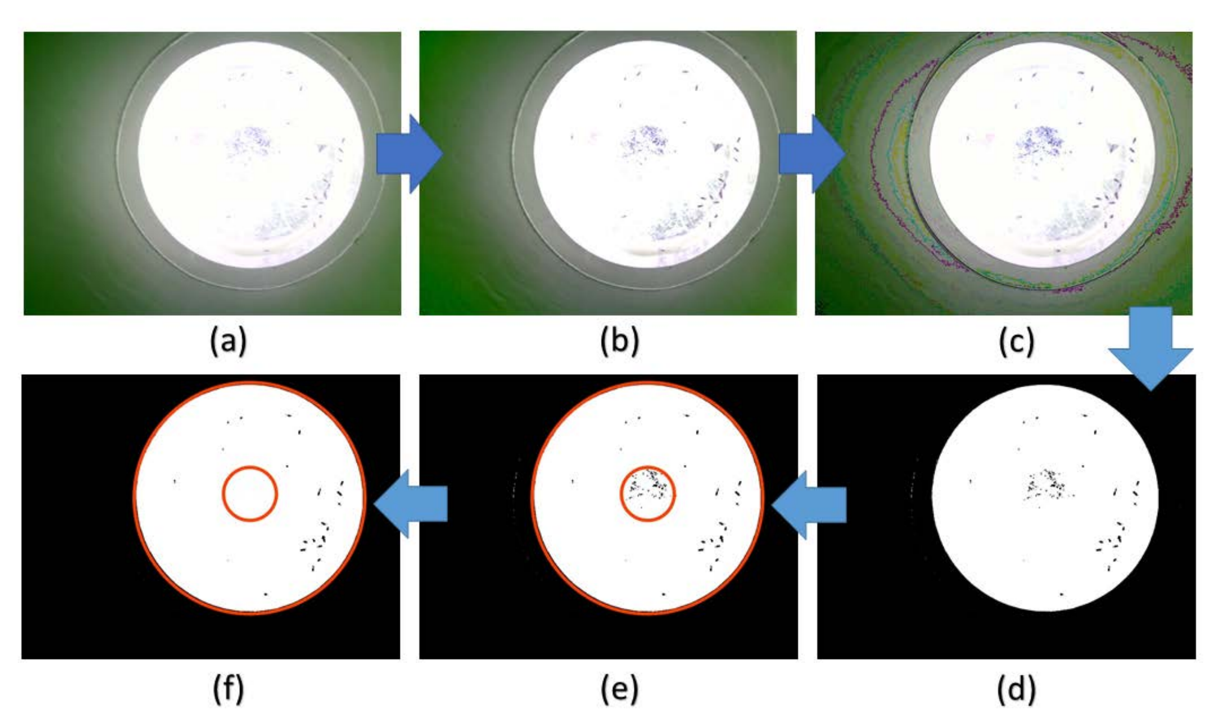
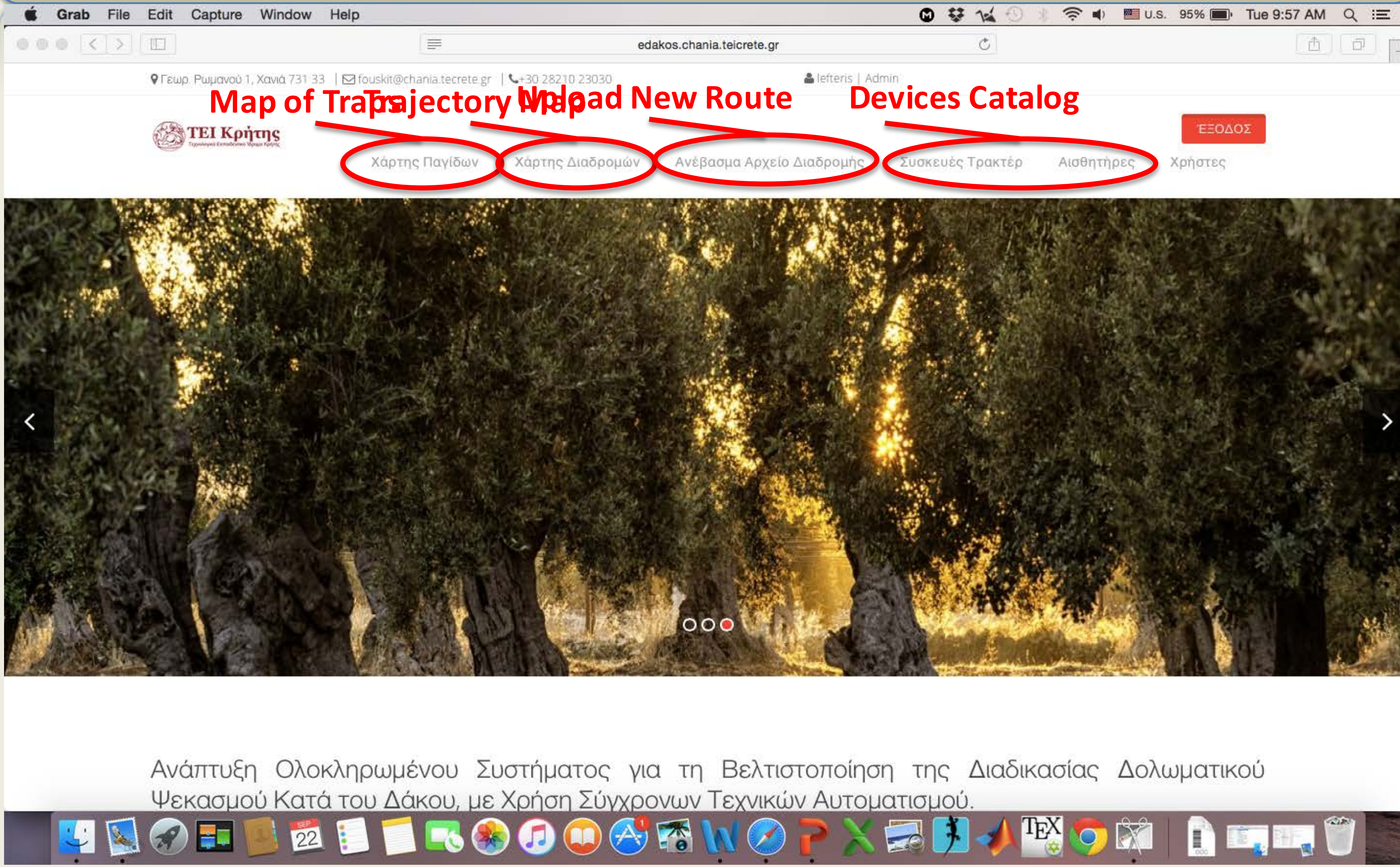



- ✓ 200 Images were used to evaluate the efficiency of our approach
  - ✓ The results demonstrated that the proposed method could accurately identify the trapped olive-fruit flies by 84%.
  - ✓ It is worth noting that in the case of processing daylight-captured images only, the success rate increased to 95%.

# Automated McPhail Trap – Web Interface



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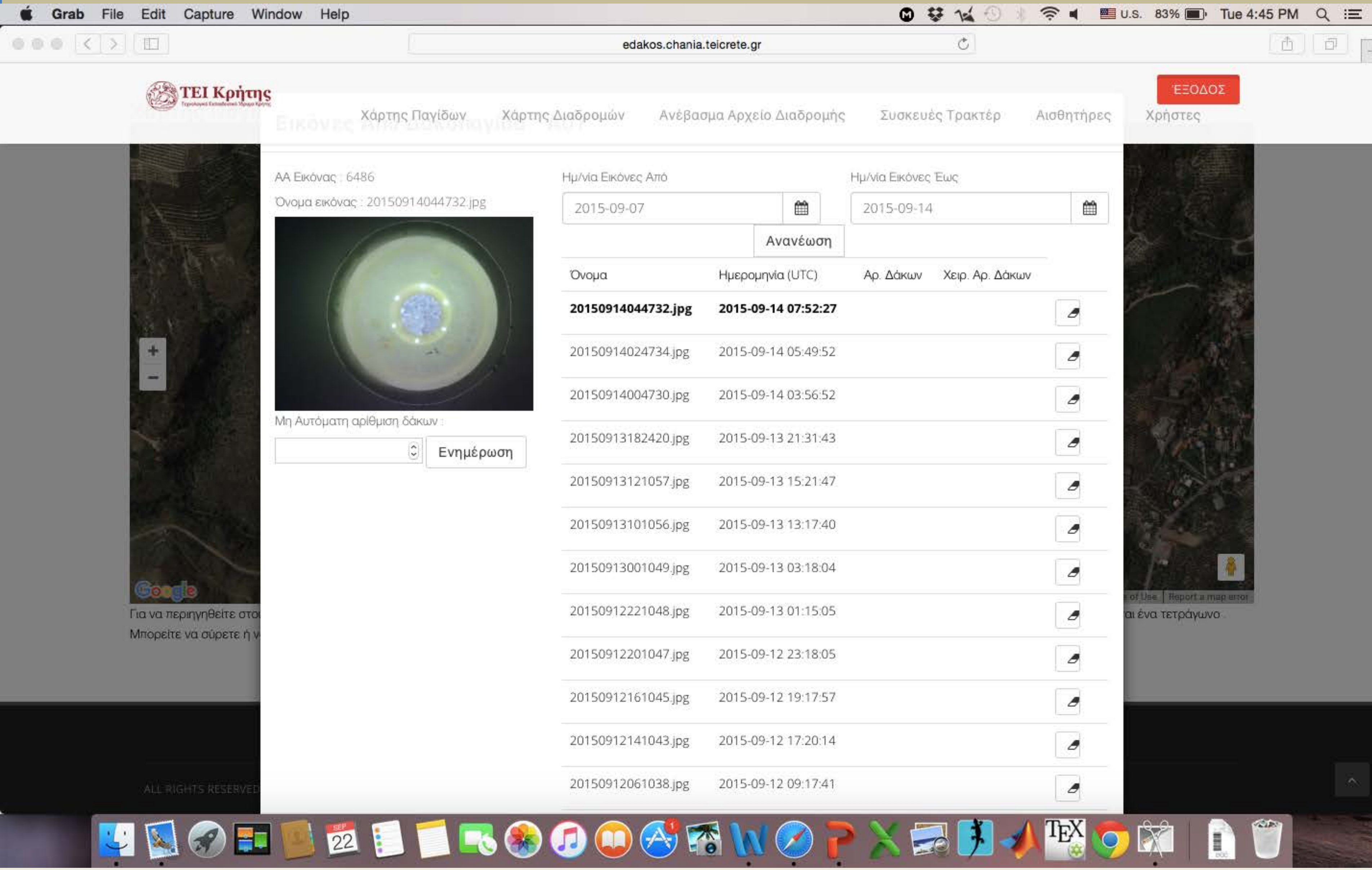
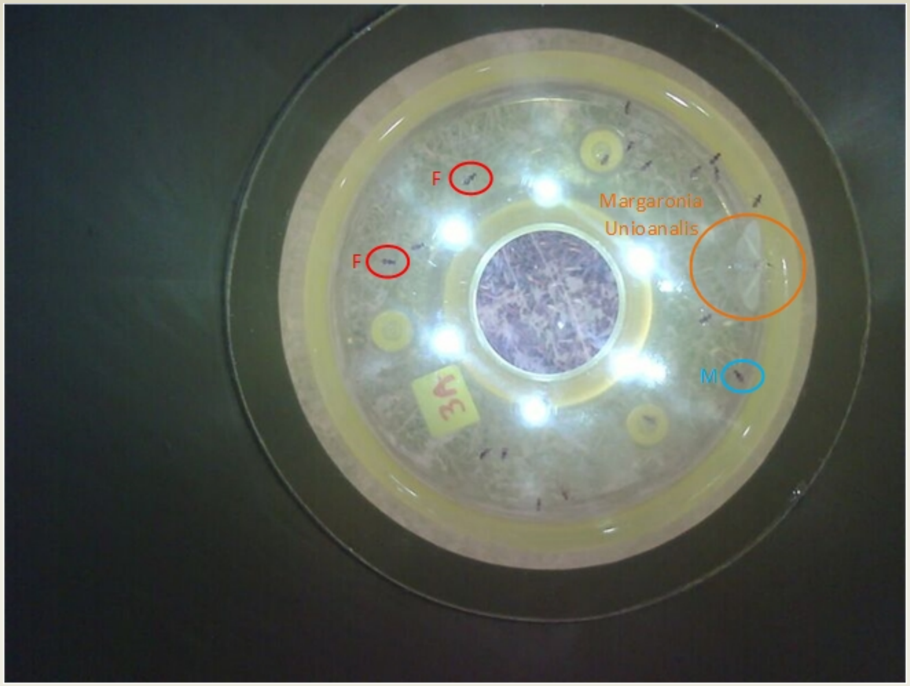
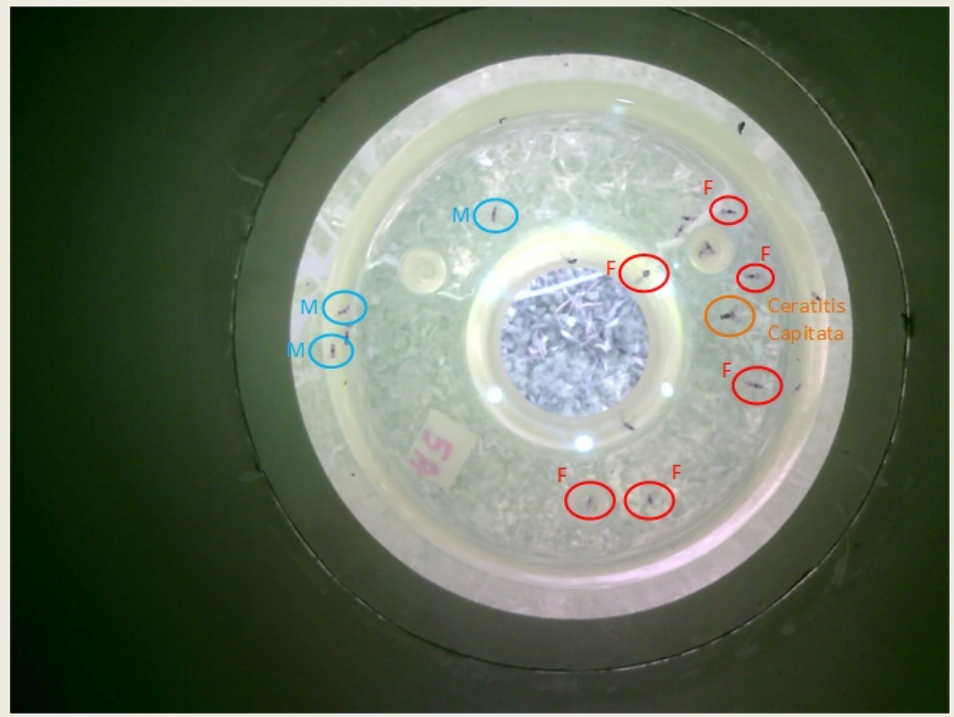


# Automated McPhail Trap – Automatic Dacus Recognition



# Future Work - Challenges

- Further experimentations in the area of automated Dacus recognition. This is essential especially in the case of large trap networks
- Reduce the cost of the prototype by optimizing the design
- Use local area communication networks
- Enhance the design of the trap by adding different sensors (i.e. environmental)
- Add equipment that will enhance the autonomy of the device (i.e. small solar panels).

*Thank you!!!!!*

*Questions?*