

# IoT-based Monitoring and Decision Support of Honeybees

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## AIM OF THE PROJECT:

This work is about monitoring bioecological timeseries data from a beehive in order to record habits of honeybees. For this purpose, an optimized smart beehive was created, multidimensional timeseries were produced and machine learning techniques were applied. All that data can be integrated to a Decision Support System that issues alert messages.

## MATERIALS AND METHODS:

An embedded system gathers data from CO<sub>2</sub> concentration (ppm), concentration of volatile compounds (ppb), temperature and humidity as well as bees counts of entering and exiting the hive. The platform also transmits exact sampling time, GPS coordinates and weight. These data constitute a multidimensional timeseries that can be analyzed by machine learning techniques to identify current trends in sensors' values, predict future outcomes and regions of confidence around them but most of all, identify atypical values that may relate to hazardous situations for the health of the beehive.

## DATA RECORDING APPARATURES OF THE BEEHIVE:



1. Scale (placed under the beehive). Provides data regarding the hive's weight (1)
2. Temperature, humidity, CO<sub>2</sub> and volatile sensor (placed inside the beehive) (2)
3. System for collecting and transmitting data from the sensors to cloud server (placed on the beehive) (3)
4. Bee Counter. Counts entering and exiting bees, separately (placed at the entrance of the beehive) (4)



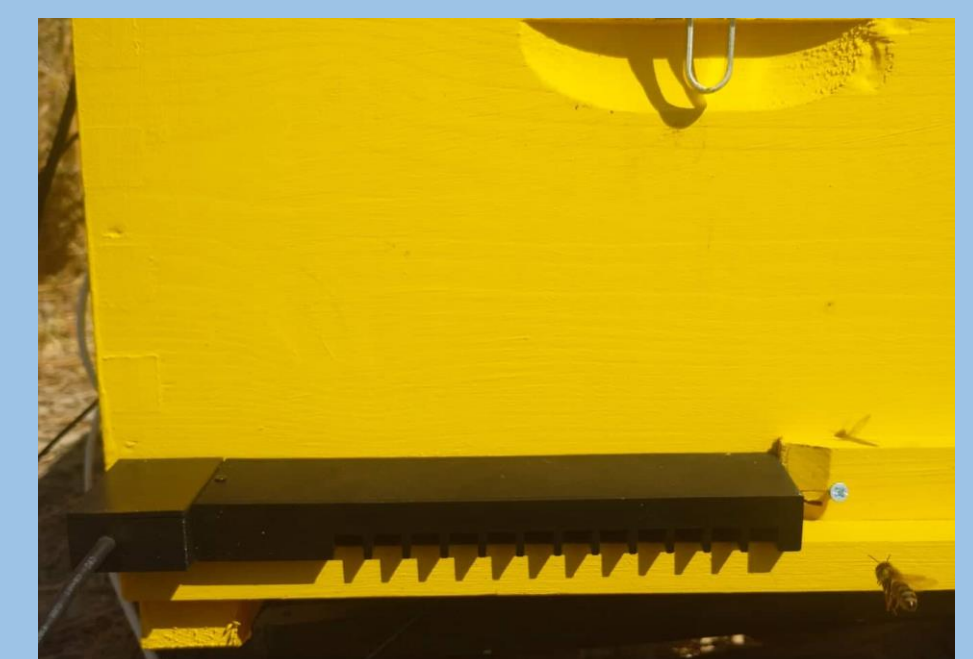
(1)



(2)



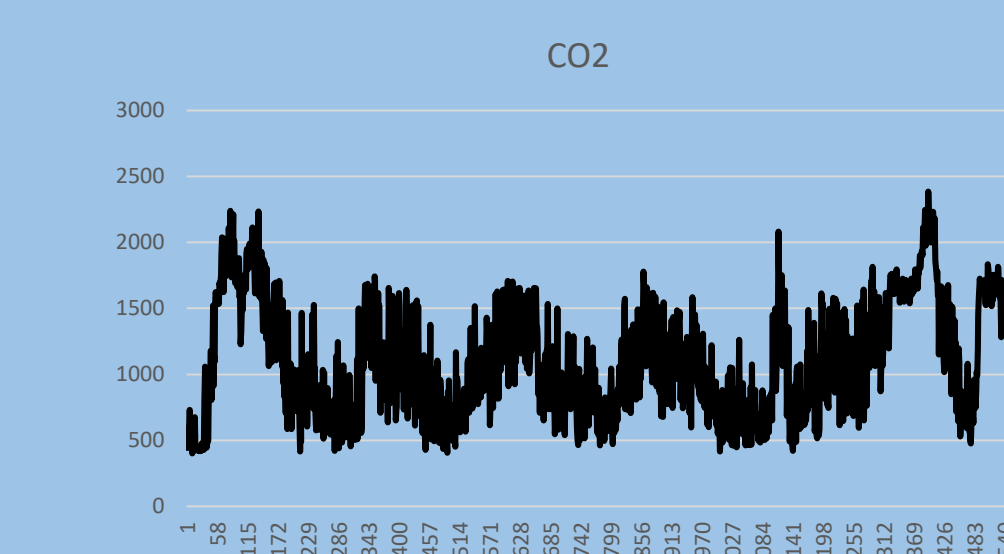
(3)



(4)

## RESULTS AND DISCUSSION

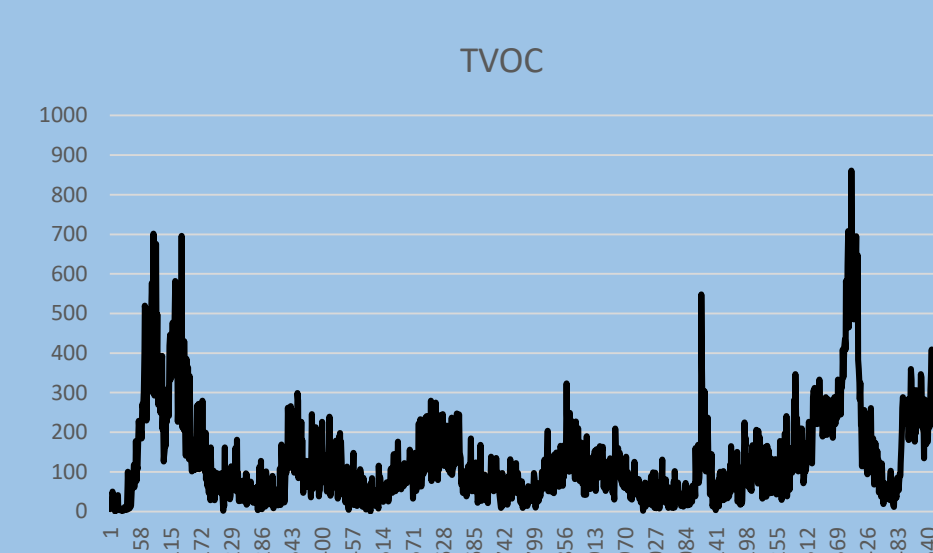
- The presented electronic hive replaced the first version of project's hive
- During 4-10 October the system has transmitted data 1541 times (X axis of the graphs)
- The weight of the hive provides information about the honey production of the bees
- CO<sub>2</sub> levels (ppm) provide information about colony's health. High levels indicate problem
- In and out counts of the bee's provide information about the collector worker bees. Many counts (Ins and outs) indicate that there are many blossom flowers in the area
- The project is going to last till June 2023. Until then a large amount of data is going to be gathered and processed
- Correlation and evaluation of the data provided will lead to the creation of a Decision Support System very valuable to beekeepers



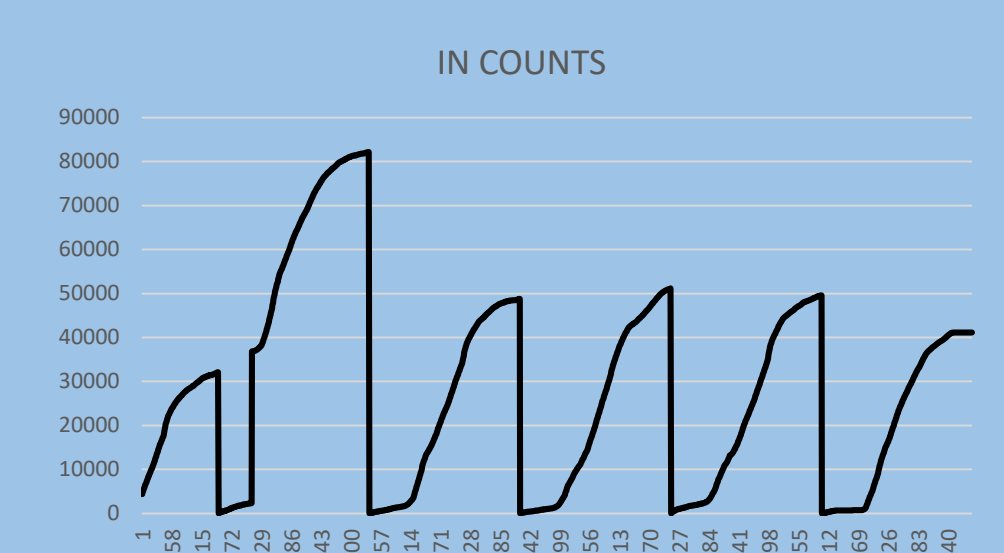
Graph 1: CO<sub>2</sub> (ppm) Concentration inside the beehive



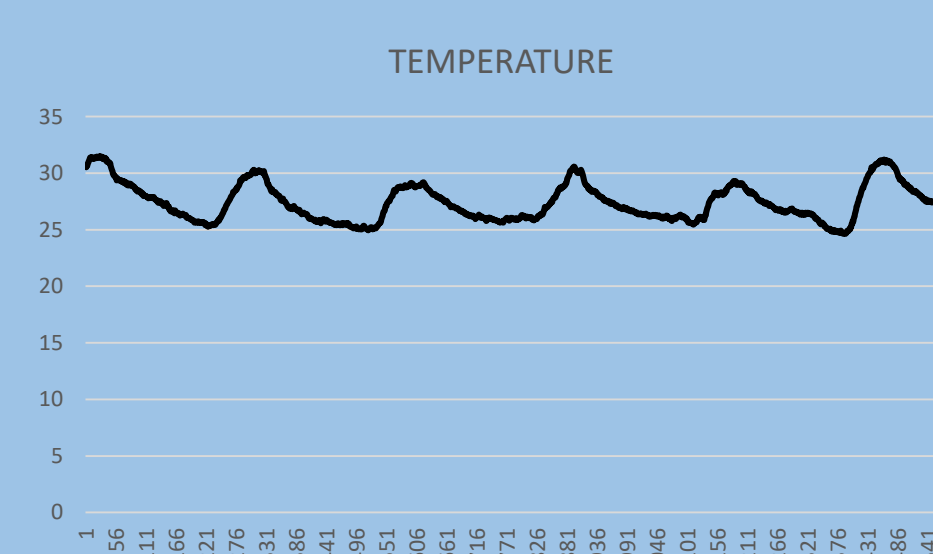
Graph 2: Weight of the beehive



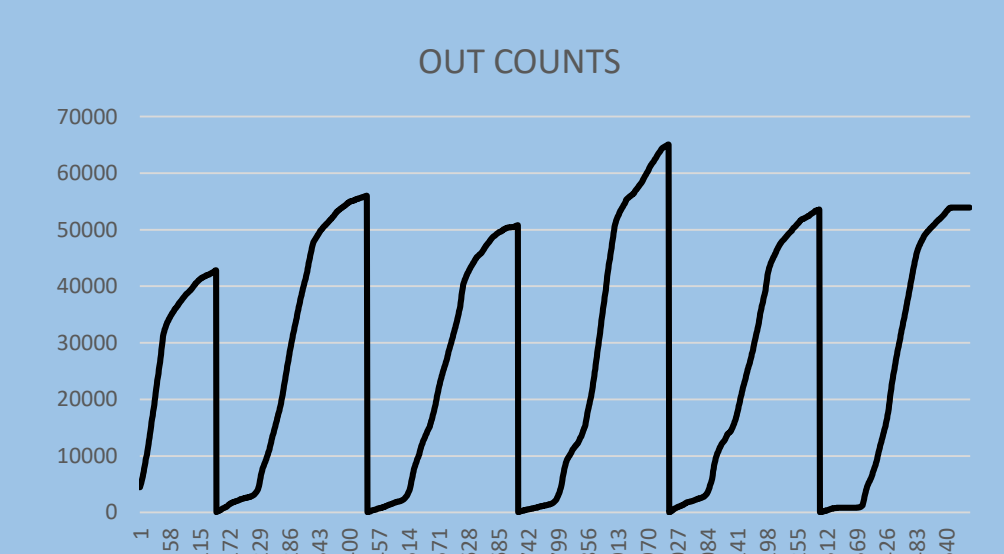
Graph 3: Volatile Compounds (ppm)



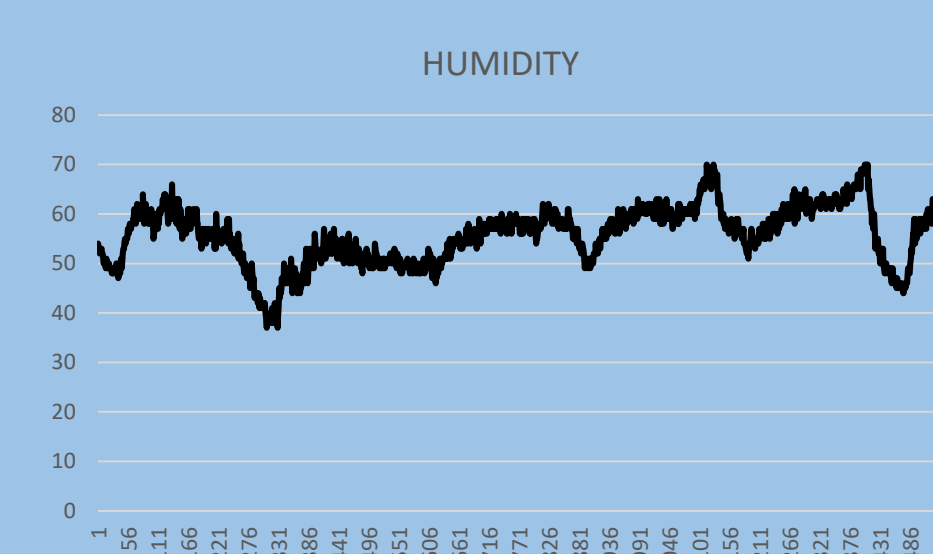
Graph 4: Bees entering the hive



Graph 5: Temperature inside the hive



Graph 6: Bees exiting the hive



Graph 7: Relative humidity inside the hive (%)

This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE-BeeSense Project (project code: T2EDK -03157)»

