

## MONITORIZING SYSTEM OF BEE FAMILIES ACTIVITY

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**Abstract.** *Climate conditions have a decisive influence on the development of the flora and fauna. Plants produce nectar and pollen which constitute the main food for bee colonies, representing the raw material for honey. It is obvious that in these conditions the behaviour, development, health, honey production etc. of the bee colonies are influenced by the climate conditions of the zone in which they live and develop. Of course in this context we should take into account the influence of other factors such as the shape of the beehive, the materials used for building it, the position of the apiary, the orientation of the beehives. At present most of the research in the field of apiculture refers to the quality of honey, the technology of preparing it, the influence of the environment on the quality of honey etc. , and only a part of it deals with the influence of climate conditions such as temperature, humidity, dew point, atmospheric pressure, noises, vibrations etc., on the lives and development of the bee families. In this work we are going to present a way of framing the most recent types of temperature and relative humidity sensors, SHT11 / SHT77, in a monitorizing device for the study of the influence of temperature, relative humidity and dew point of the environment on the life conditions of the bee families in beehives. As a medium of the development of monitorizing we used the Lookout programmes drawn up by the American firm National Instruments.*

**Keywords:** *Data acquisition, data processing, hive internal temperature, hive internal humidity, hive internal dew point.*

### Introduction

It is known that the activity of bee families has as a result produces such as: honey, wax, propolis, queen milk, bee venom, apilarnil, etc., produces which are used either directly as human food (honey) or as raw material for an impressive number of medicinal, cosmetic, pastry produces, etc. [1], [6]. On the other hand it is known that the active period of producing the produces mentioned above by bee families is extremely variable according to different areas of the earth, depending a climate and relief conditions.

Climate conditions have a decisive influence mainly on the development of the flora and fauna. When blossoming, plants produce nectar and pollen which at the same time constitute the principal food of the bee families. So the life and

behaviour of the bee colonies, the honey production, their health and development are highly related to the climate conditions of the region where they live and develop.

For the Romanian zone which is characterised by a large variety of relief, the climate presents a cyclic evolution with its specific season: spring, summer, autumn and winter. These periods are cyclic, but not the same, presenting important differences concerning the duration, temperature and hygrometry.

In this context the active period of bee colonies for the Romanian zone is unfortunately reduced to an interval of about 180 days / year when the bee families can go out, feed naturally and develop.

During the other periods of time they prepare for winter, wintering and brood rearing, these periods being accompanied by a great natural

and artificial food consuming influenced by the climate conditions specific to that period.

It is also known that honey is an excellent produce which monitorizes the quality of the environment. Most of the recent scientific research in the field of apiculture refer to this problem because the quality of the main produces of the bee families depends on the quality of the environment and the treatment applied to bee families[1],[5].

The aim of this work is to present a monitoring system conceived and achieved by means of the most recent software and hardware products attachable to a bee family, having in view the non stop supervising of the climate conditions of the environment (temperature, humidity and dew point), respectively their influence on the conditions in the beehive.

The aim of monitoring is to find some undesirable influences as well as to achieve proper developing conditions for the bee families, by proper intervention. Consulting the bibliography we haven't found any approaches in which several simultaneous parameters could be followed. The works [1], [2], [3], [4] and [7] deal only with the influence of the environmental temperature on the duration of the active period and on the temperature inside the beehives.

In order to monitorize we have proposed to measure non stop and to register, by means of sensors, the temperature and relative humidity around the beehive, respectively to measure and register the variations of the same parameters in different zones inside the beehive by means of three movable sensors [8], [9], [10], [11], [12].

### The hardware realization

In order to measure the temperature and relative humidity we have adapted the new product SHT11, made by the firm Sensirion AG, with the technology of CMOS [9], fig.1.

The device SHT11 of very small size, only 5,08x 7,62 mm, that can be set either to a surface, or with the help of the pines, includes beside the temperature and relative humidity sensor of analogic type based on polymer as a dielectric, an A/D converter, a calibration

memory and a digital 2-wire interface and CRC generator, having four terminals: GND, VDD, DATA and SCK, fig.2.

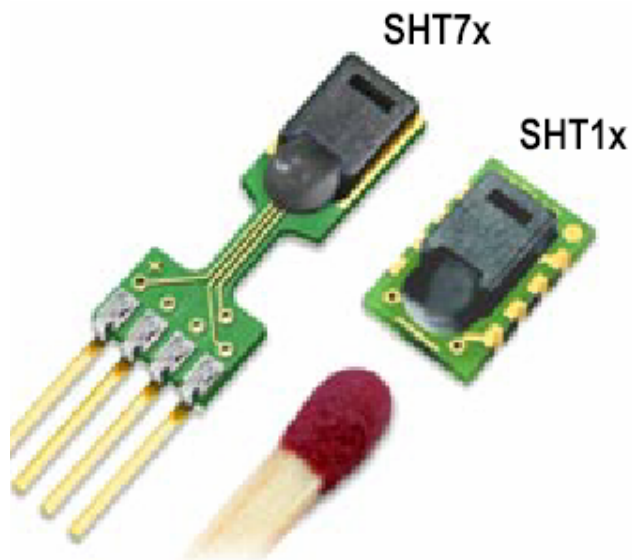


Fig. 1. The SHT 11 and SHT77 sensors

In order to acquire and transmit data at the distance, from the three planned measurement points (the outside of the beehive, in different internal points of the beehive) there have been incorporated three sensors of SHT11 type in modular structures, fig. 3, that use two integrated circuits each SN75179BP (Differential Driver and Receiver Pair) [10], forming the transducers T1, T2 and T3.

### Block Diagram

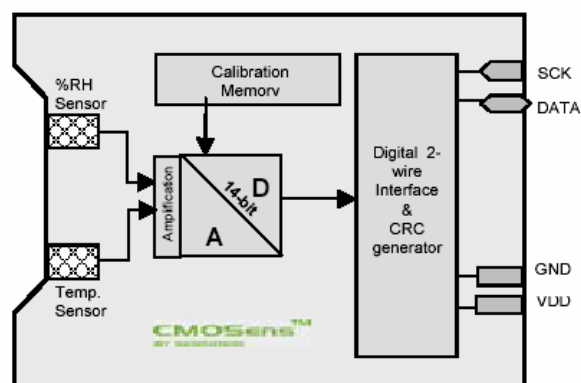


Fig. 2. The SHT11 Block Diagram

This way we can achieve a bidirectional transmission of data and commands between sensors and a point of data acquisition

materialised by the module HIT-03, fig.4. From this module, data are transmitted through serial

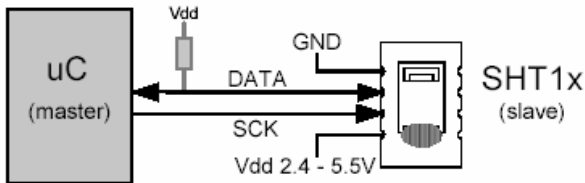


Fig. 3. The SHT11 typical application circuit

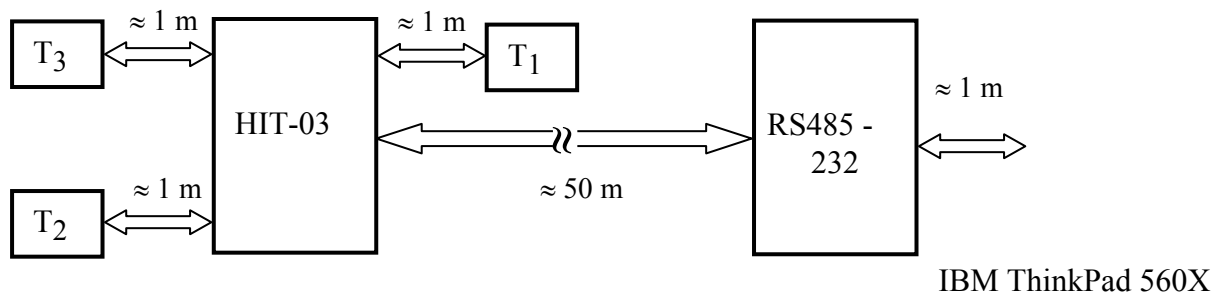


Fig. 4. The communication structure

### The Lookout development medium

The Lookout development medium is an object oriented automation system, with complete characteristics and access functions to WEB. It is used for HMI and SCADA applications. It offers a big power and it is easy to use in industrial measurement applications and controls with severe requirements.

The technology which makes it so easy to use is the object based architecture and sub adjacent methodology for the creation of the object based applications. The adjusting of the applications and the ulterior modifications are made wholly on the fly, to assure the controlled processes to develop and to carry on without interruptions [8], [11] and [12].

Because Lookout has a characteristic the event driven objects achievement (event-driven structure), it is used in numerical systems, continuous, in lots, or in telemetry, applications which require high performance and/or supervision of a very high number of points.

Lookout disposes of objects achieved in C/C++ medium and which are divided into system object classes which are absolutely necessary to run applications and object classes which are used for the communication with physical

communication RS485 / 422, at about 50 m distance, to a convector RS485 / 422 → RS232 in order to connect it to a computer.

In order to acquire and monitorize we use an IBM ThinkPad 560X, Pentium 233, 256 M RAM and HDD 4GB computer.

medium.

The Lookout screen can be used in two modes: *edit mode* in which any application which rules can be modified and *active mode* in which the application can be only ruled.

The workspace is represented by panels, on which, depending on necessity objects can be added or extracted. The central panels are visible screen zone on which there are objects and parameters utilized by the application. On these panels they can display complete schemes of the supervised and/or controlled equipment.

The application files are of three types: source files with the extension .lks, executable files with the extension .l4p and data files with the extension .l4t.

### The software realization

The application, achieved by means of the Lookout development medium for the continuous monitoring and registering of the obtained data by means of the transducers T1, T2 and T3, in fig.4, has as a basis a main panel which opens simultaneously with the launching of the application in work.

The image of the main panel is presented in fig.5.

We can notice the following main parts of the panel:

-**Title Bar**, displays the name of the programme and the title of the currently executed process;

-**Menu Bar**, with the current available menus:

File, Edit, Option, Alarms, Windows, Run and Help that uses in the Run mode of work and respective File, Edit, Insert, Object, Arrange, Change, Option, Alarm, Windows and Help that

uses in the Edit mode of work. The commands in Menu Bar can or cannot be available for an operator depending on the security level established by the designer.

-**Front Panel workspace**, is the space ranging between **Menu Bar** and **Status Bar** (which does not appear in fig.5) and in which different objects for the visualization and manipulation of data and events may appear.

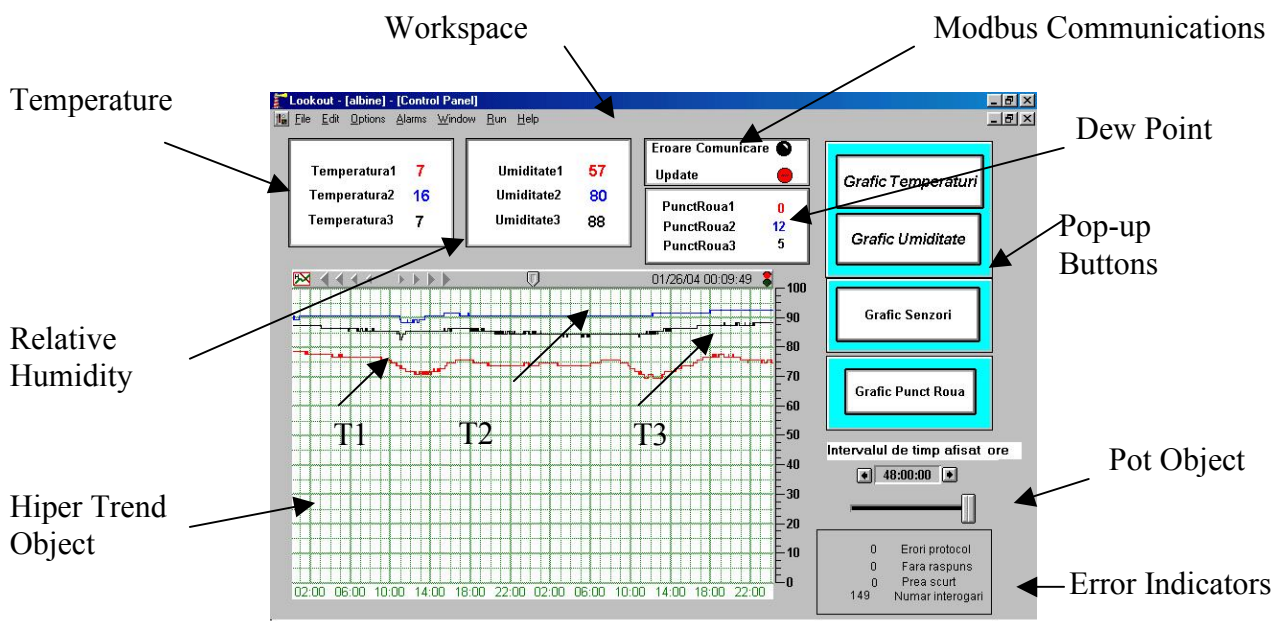


Fig. 5. The main Front Panel

The principle of achieving an application in Lookout is based on the creation of objects and then of their connection to one another depending on the necessities of the application.

For this purpose we proceed to **Edit mode** on the **Menu Bar**. The menu *Object>>Object Explorer*, allows the selection of a wanted object. The objects Lookout are characterized by: *functionality*, *tagname*, *parameters* (logical, numerical, text) and by a *database* (data members) specific to each object (logical data member, numerical data member, text data member).

We can notice two main groups of Lookout objects:

-**Lookout System Object** – with their help we can achieve the wanted application;

-**Lookout Driver Object** – with their help we achieve the connection to the exterior equipment by means of plug and play data acquisition module or serial ports, in order to effect data acquisition, command and controls.

Lookout Objects, selectable from a very wide range, appear on the Front Panel as graphic elements, having a suggestive shapes (display format) and can be *static* or *dynamic*.

The static graphic elements appear as pictures without any possibility of changing while the dynamic graphic elements modify their state depending on the process variables or on the events that take place.

So on the front panel we created three objects with graphic elements of *Device Expression* type for the acquisition and presentation of the

variable parameters: temperature, relative humidity and dew points. Then we created the object *Device Expression* type, which controls the data acquisition by means of Modbus protocol. In these graphic elements the latest values of the acquired parameters are displayed. In the last graphic element mentioned above information about the Modbus communication, “*Modbus1.CommFail*”, together with the moments of updating the information “*Modbus1.Update*” in “*Citadel historical database*” are displayed. In case of the achieved programme the information is made actual at every 5 seconds.

Down on the left side the graphic element of a “*HyperTrend Object*” appears; it can access the stored data in “*Citadel historical database*” of each acquired parameter. We can notice that the object HyperTrend is like a window in the data base; it means that any segment of stored data can be visualised by means of some buttons provided for this aim. For this purpose on the right side of the object HyperTrend we set a

“*Pot Object*” provided on the top of it with a numeric indicator of “00:00:00” type (hours, minutes, and seconds) which allows the selection of the length of the window in the data base.

The selectable interval ranges, from 10 minutes to 48 hours, depending on what the user prefers.

For evaluating the data as easily as possible the ordinates of the diagrams were scaled like this:

- temperatures: from -50 to +70°C;
- relative humidity : in %;
- dew point : from -50 to +70°C.

On the right side of the window of the main panel there are three graphic elements which correspond to some “*Revice pushbutton*” objects and which by pressing allow some secondary panels to appear; they have the size of the whole screen in which the variation graphics of the acquired parameters saved on the data basis of each object are presented.

Table 1. A sequence of registered data on 02.11.2004

Time	Temp1	Temp2	Temp3	Hum1	Hum2	Hum3	DewP1	DewP2	DewP3
2/11/04 0:00	-3	-2	-1	68	67	84	-8	-7	-3
2/11/04 0:10	-3	-2	-1	67	67	84	-8	-7	-3
2/11/04 0:20	-3	-2	-1	66	67	84	-8	-7	-3
2/11/04 0:30	-3	-2	-1	64	67	84	-8	-7	-3
2/11/04 0:40	-3	-2	-2	63	67	84	-9	-7	-4
2/11/04 0:50	-3	-2	-2	62	66	84	-9	-7	-4
2/11/04 1:00	-3	-2	-2	61	66	84	-9	-7	-4
2/11/04 1:10	-3	-2	-2	61	66	84	-9	-7	-4
2/11/04 1:20	-3	-2	-2	60	66	84	-9	-7	-4
2/11/04 1:30	-3	-2	-2	59	66	84	-9	-7	-4
2/11/04 1:40	-3	-2	-2	57	66	84	-10	-7	-4
2/11/04 1:50	-3	-2	-2	57	66	84	-10	-7	-4
2/11/04 2:00	-3	-2	-2	56	66	84	-10	-7	-4
2/11/04 2:10	-3	-2	-2	56	66	84	-10	-7	-4
2/11/04 2:20	-3	-2	-2	55	66	84	-10	-7	-4
2/11/04 2:30	-3	-2	-2	55	66	83	-10	-7	-4
2/11/04 2:40	-3	-2	-2	55	66	83	-10	-7	-4
2/11/04 2:50	-3	-2	-2	55	66	83	-10	-7	-4

Down on the right side of the main panel the graphic element of an object “Revice expression” appears which is used to display the communication errors on Modbus. Therefore we have the following errors:

- *Modbus1.Protocol Errors*;
- *Modbus1.No Response*;
- *Modbus1.Tooshort* and *Number of Pollings*.

Having in view the processing of the future data, these are saved by means of “*spreadsheet logger*”, of the Lookout medium in ASCII files with the extension “*\*\*\*.csv*”. The saving is registered according to the year, month and

days, every 10 minutes, containing all the six parameters and the moments of their acquisition; a sequence of registering is presented in Table.1.

### The experimental results

From the above presentation results that in the graphic elements Temperature, Relative Humidity and Dew Point on the Front Panel, the values of the acquired sizes can be visualised in real time every 5 seconds and in HyperTrend Object windows from the data basis, actual or past can be visualised too.

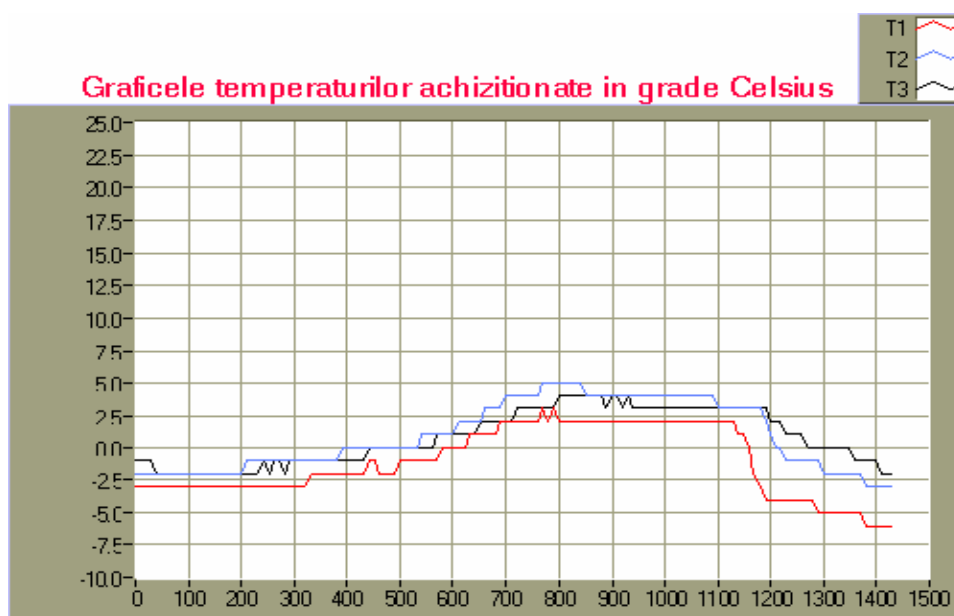


Fig.6. The evolution of temperature on 02.11.2004

Only groups of three parameters of the same type can be visualised at the same time: temperature, relative humidity, or the dew point. The selection of the wanted parameter groups as well as the width of the window of the data basis depends on what the user prefers. In table 1 we presented the acquired data saved by means of “*spreadsheet logger*”, on 02.11.2004 between 0:00 and 2:50.

It is obvious that owing to the established frequency of acquisition, a saving at 10 minutes, the table has 144 lines.

Then with the help of these data we built the diagrams in fig.6, 7 and 8 of the temperature, relative humidity and dew point, using the

development medium Lab VIEW. The transducers were set round a beehive, without bees first, to check the correct achievement of the system. The transducer T1 was set under the beehive which is 50 cm from the soil; T2 was set in the space with empty frames, while T3 was set in the space that remained free in the beehive.

The scales of representation were modified regarding temperature and dew point, in order to be read more easily.

The achieved system works non stop from 01.07.2004; at present the transducers are set in the hive with bees.

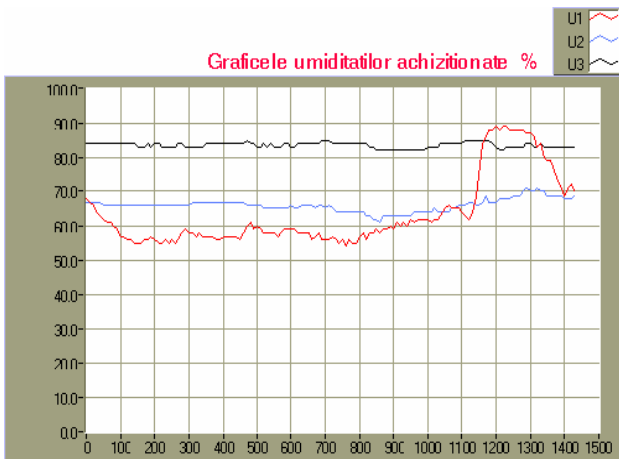


Fig.7 The evolution of relative humidities on 02.11.2004

## Conclusions

On the basis of watching the device daily, respectively of the data acquired so far we noticed the special utility of the system achieved in order to effect some hard experimental research concerning the effect of some environmental conditions on the life and development of bee colonies in the Moldova zone.

Researches are to be extended by monitoring the influence of the other parameters mentioned above.

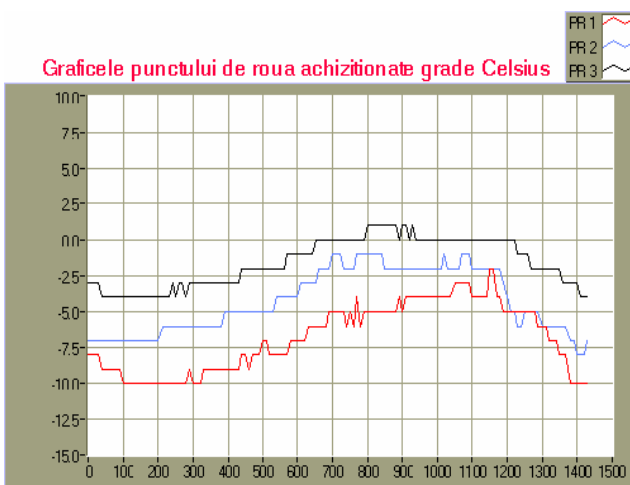


Fig.8. The evolution of the dew points on 02.11.2004

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