Project B

Seven Years of Day-to-Day User Experience of the CC Air Service

Beekeepers are never asked how they are, they are more likely to be asked: "How are the bees?" Many factors could contribute to the answer, but one of the most important ones is hive temperature. This was the reason why in March 2014 I jumped at the chance to put sensors in my beehives, which were provided by Commerce-Connections. This gave me real-time remote monitoring of temperature and humidity in my beehives, with historic records for analysis and comparison.

At the apiary, the system comprised six robust sensors measuring 72mm x 124mm x 31mm, situated above the crown board in each beehive and one in a decorative, empty beehive to record ambient conditions. Both temperature and humidity readings were recorded by wireless connections: via a repeater, aerial, receiver, and minicomputer uploaded to the CC Cloud Services, displaying on a PC in my home or on my smart phone using the CC Air Service App. It is reassuring that the minicomputer can be accessed by a CC administrator for

remote support, if necessary. The temperature recorded was not absolute, as the sensors were remote from the bees, but they reflected what was happening in the hive. Equally though, the humidity was monitored remotely from the bees and it was not considered to be of any value at that time.

The PC in my house is about 100 metres from the apiary, with numerous trees in various stages of leaf and houses in between, necessitating a repeater halfway. At the house, the outside aerial is hard wired to the computer via a receiver and minicomputer which are connected to a router/modem. In normal operation the minicomputer is fully lit. On start-up it was necessary to determine the most suitable aerial and its location outside the house and to establish the best position for a repeater about halfway between the house and the apiary. No Wi-Fi or mains electrical power was required at the apiary. Two screens were available, see figures 1 and 2. The temperature readings were variable producing a readable curve.

On the screen all hives are displayed together showing their respective hive number, minutes since last reading, actual temperature, and humidity. The "minutes ago" reference changes from green to orange at 10 minutes. Other screens show graphs for individual hives recording temperatures for today, 7 days and 14 days (figure 1). On all screens temperature is shown as degree Celsius and time of the reading as hours, minutes and seconds (figure 2).

Figure 1

Temperature and humidity (internal sensors)

50333390	50333391	50333392	50333403	50333413
HIVE MF6	HIVE MF5	HIVE MF4	HIVE MF3	HIVE MF2
17 minutes ago	6 minutes ago	5 minutes ago	5 minutes ago	3 minutes ago
22.8°C	**23.4°C**	**23.2°C**	**22.4°C**	**23°C**
71%	**69%**	**67%**	**71%**	**69%**

50333415	50333436
HIVE MF1	Ambient HIVE Outdoor
3 minutes ago	4 minutes ago
23°C	**22.6°C**
69%	**70%**

Figure 2

Sensor ID: 50333390	Tags: HIVE MF6
Sensor Type: 2	Account: recycle

Start: 18-03-2021   End: 24-03-2021   Update

Today   7 days   14 days

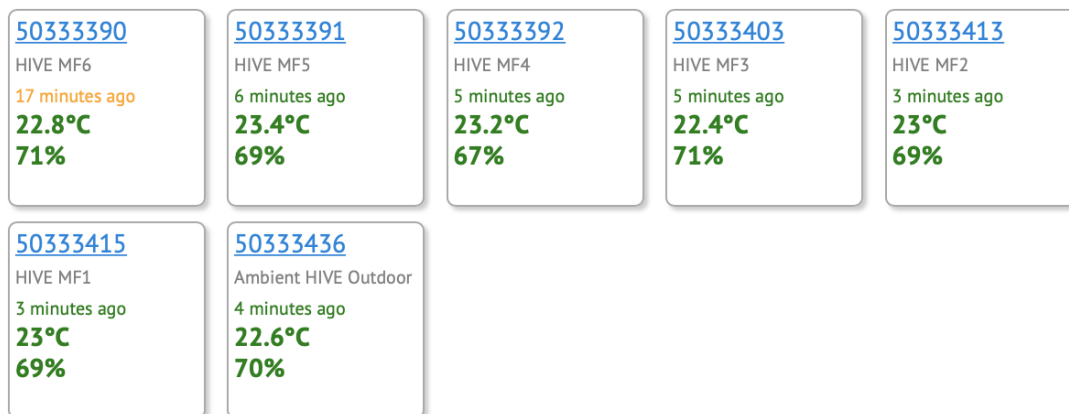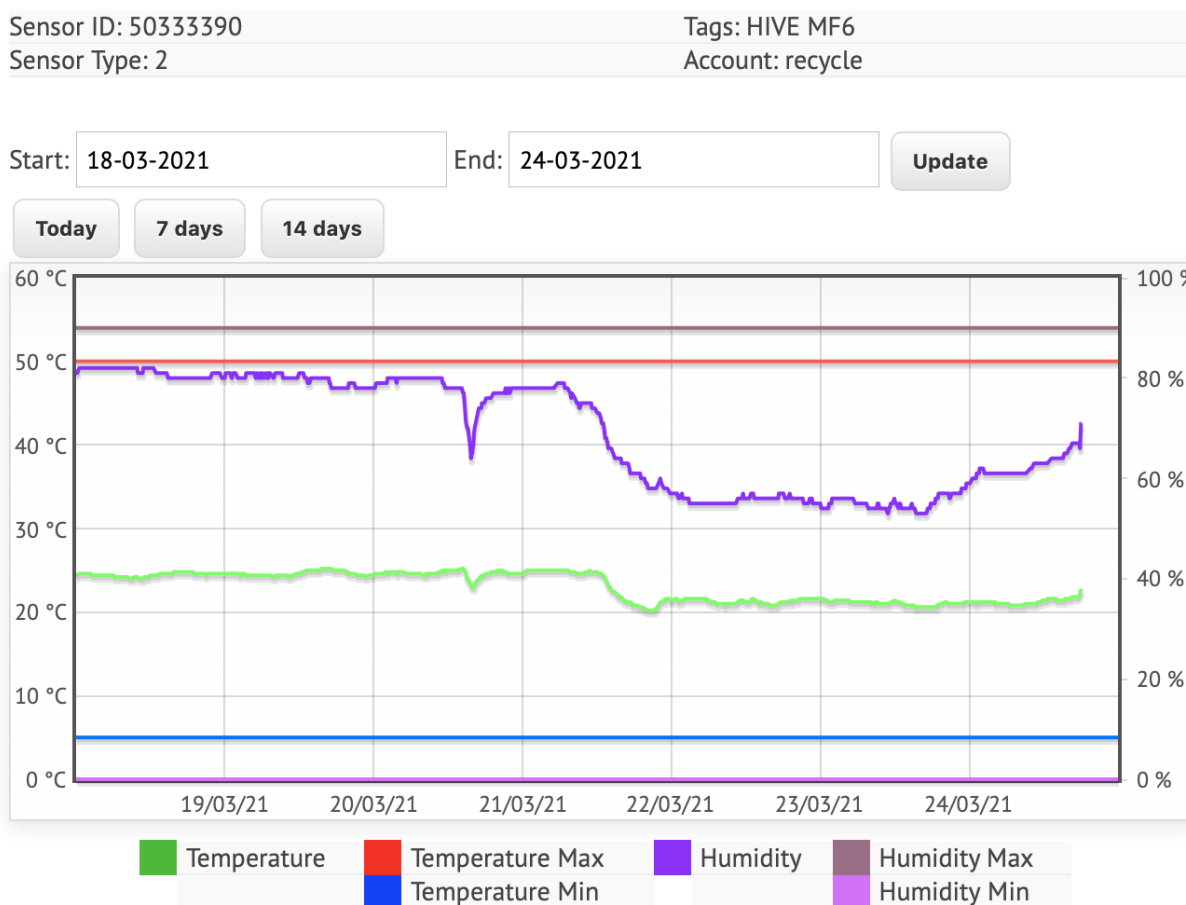Temperature   Temperature Max   Humidity   Humidity Max
Temperature Min   Humidity Min

Commerce-Connections recommends that the two AA batteries in each sensor are changed every year, obviating the need for a low battery alert. If left, the batteries lasted 2/3 years when they were changed simultaneously, the voltage being checked at about 1.6.

Advantages of the Commerce-Connections system to the beekeeper:

- Unnecessary trips to the apiary are avoided. A quick check on the computer to see all is well saves a visit to the apiary.
- Unexpected variation between hives temperatures and ambient temperature often gives a clue something is wrong.
- It is apparent, if a bee colony has died out for any reason.
- Useful to compare data from different hives to see any variation in temperature.
- Even the time and duration of roof removal for inspection may be determined.
- As the bees move up into the feeders, when the weather improves in the spring, an increase in temperature can be detected.
- If the bees have swarmed, half of one's bees have been lost, causing a reduction in the hive temperature.
- High and low alerts may be set within the standard temperature range of - 30 degree C to + 50 degree C and these trigger frequent emails until the problem is resolved or the alert setting is changed.
- High or low temperatures in the hives due to excessive weather conditions may be avoided with shading or insulation.
- The beekeeper is alerted, if the hives are stolen.

The Commerce-Connections system, which I have been using successfully for seven years, has made my beekeeping a lot easier.

The analysis on the screen provides invaluable insight into the aspect of a hive's status. Being remote from the apiary, a quick check on the computer every day gave me peace of mind.

Whilst the variations in times between readings have not affected my ability to use the system effectively, some development work may be necessary for medical, industrial, and agricultural applications where there is potential. It appears that the variation in time between readings could be a function of the distance between sensor and receiver, obstructions between, the design of the aerial and possibly battery life.

Many claims are made for the validity of recording other functions in the beehive (such as noise levels, light, vibration, and humidity) but, to my mind, the only one of value, in addition to temperature, would be weight or, more particularly, weight variation. Colony development, honey storage and food consumption are all weight related and of interest to the beekeeper.

CC Air Service relies on the SOT-30x sensor family. This is an extremely flexible range of wireless sensor units that can measure temperature and humidity using SoC (System-on-Chip) technology. For maximum durability and protection against the elements, the electronic components are fully sealed inside a PUR casting compound. With a temperature resolution of 0.1°C the sensor unit can be configured to measure temperatures from -30°C to 125°C. For situations where the temperature can melt plastic, a proprietary thermal probe can be used. The data communication is wireless, transmitted on the ISM band for maximum range. Using AA batteries keeps the weight of the sensor down to a low 190g.

The sensors allow continuous monitoring of temperature and humidity and Commerce-Connections can integrate the data into almost any back-end system. Historic data can be stored for future analysis according to HACCP regulations. Custom alerts can trigger corrective action 24/7 according to user-defined temperature and humidity conditions. Applications reach beyond just food storage specifications, like Project B, the sensor units can be applied to deep-freeze cabinets, restaurant air-conditioning, live organ transport/storage and wine/beer fermentation.

Smart Sensor casing
(actual size: 72mm x 124mm x 31mm)