**Q 1. You are tasked with selection of sensors for smart beehive monitoring. What will be the parameters of your selection criteria?**

Ans.

There are several parameters to consider when it comes to beehive monitoring. But, weight of the beehive is the most crucial parameter. To weigh the beehive, which contains numerous frames, a weighing scale could be used. As Dr Omar explained, weighing the beehive was found the most efficient way as the weight of the hive reveals the population in the hive, which indirectly relates to lot of information about the hive. He tracked the time the beehive had a reduced weight, this denoted that the worker bees have left to collect nectar and pollen. He could track the health of the hive by comparing a range of data from different days as the bees followed the same routine, the worker bees left the hive only at a particular time of the day. Another important parameter is temperature as the brood (larva, egg and pupa) require a certain temperature to get a healthy growth. Regulating the hive temperature is very demanding on the worker bees that it ruins their food collection schedule thereby reducing the efficiency of the hive. Based on the information that Dr Omar shared, I would choose either weight or temperature as the crucial parameters to monitor beehives.

**Q2. How is machine learning deployed by Dr Omar in the project of “Internet of Beehives”?**

Ans.

Dr Omar initially gathered data from experienced beekeepers of a healthy and well-functioning beehive (the dataset). Then he used a range of sensors to measure the parameters that the beekeepers would generally look for when monitoring a beehive. This data was then compared against the dataset for the machine to learn as the collected data would be from different days yielding different hive results. This would help the machine to know how the sensor data would be for a bad hive health and a good hive health. Once the machine understands the difference, the dataset is no more required and the model is ready.

Once the accuracy of the model was satisfactory, the trained machine was used to predict the results.

**Q 3. You are tasked with design of communication sub-part of a project on Beehive monitoring.**

**(a) List the challenges you should consider while designing it.**

Ans.

- The location, as this could be important when considering the network range and the interference.

- The amount of power available as this important when it comes to frequency and amount of data transferred.

- The amount of data being transferred; heavy data requires higher band with which results in higher power consumption.

**(b) What are your proposed solutions to these challenges.**

Ans.

- When the beehive is present in a remote area, the data collected from one node could be transmitted to the node that’s nearest to the main processing station. This achieved by connecting different beehive monitoring systems to each other and one system acting as the hub.

- This would also save power as only the hub that transmits a lot of data requires more power than the individual systems. If data is transmitted individually from each monitoring systems, then it would require a relatively higher power depending on the distance.

- Each system could be equipped with a power efficient processor that pre-processes the data before transmitting it. This pre-process would essentially filter the data that is just enough to get the required analysis done.

All the problems are inter-linked and solving one could potentially result in solving multiple issues.

**(c) Your boss suggests real time monitoring of the beehives. Give your reasoning in favour or against the suggestion.**

Ans.

I would stand against real-time monitoring as it requires continuous monitoring which would result in higher power usage and cost.

By tradition, beehives are monitored periodically.

The benefits of real time monitoring are not worth over the cost incurred.

Cost to benefit ratio is very low.

The cost of power and hardware used far exceed the profits obtained through real-time monitoring.

**(d) There are 100 beehives in the remote Jarrah Forest with 20 beehives having the communication transceivers. Design the communication mechanism, pointing out how you are handling the challenges listed in part (a).**

Ans.

* Since there are 100 beehives and 20 of them have the communication transceivers, these transceivers could be spaced out in 1:5 ratio. That is for every 5 beehives, one of them will be receiving the other four hives data acting as a hub and transmitting this data over a longer range. This would be a viable solution that is cost and energy efficient.
* Since the beehives are located in a remote location, a battery that is charged using solar power would be crucial. When there is enough sun light, the system could directly be powered through the solar energy, like SMPS (Switched Mode Power Supply). This battery does not have to be huge if the system on board is power efficient.
* To save power, the data being transmitted will be pre-processed, sending only the required information, by an on-board processor. This processor will be very power efficient, something like what Dr Omar used, a 48Mhz processor.