

# **RFID Tracking of a Queen Bee** Derek Boes, Wesley Thompson, Nicholas Madge Faculty Mentor: Dr. Puteri Megat Hamari ECET Department, Minnesota State University, Mankato

### BACKGROUND

The decline of pollinator populations over the past several decades has been a leading problem in topics of ecosystem diversity, crop production, food security, and human welfare. The honey bee (Figure 1) is the pollinator that is predominantly managed to enhance agricultural production [1]. Studies have shown that there is clear evidence for severe regional declines in domestic honey bee stocks in the USA (59% loss of colonies between 1947 and 2005) and Europe [1].

#### **Beekeeper Client Request**

A beekeeper came to our junior design class with the need for a system that precisely monitors and communicates to him the location and activity of a queen bee inside the hive.



Credit: Wikipedia [2]

#### Significance of the Queen Bee's Activity

The queen bee's location and activity is important for a beekeeper to know because they can ensure she is alive, and they can avoid disturbing her by not removing the shelf she is on when checking on the hive. This contributes positively to the overall health of the hive and allows the beekeeper to know the hive's state. Ensuring beekeepers across the world are maintaining healthy hives will improve the global pollinator decline issue.

### **PROPOSED SOLUTION**

The solution was a system that took a received signal strength value and indicator (RSSI) a minimum attributes to movement threshold. From there an estimated distance of the Queen Bee can be attributed to a particular range of RSSI values.

For portability, a battery powered RFID reader was chosen. With a reader, paired with an external antennae and a Windows laptop, make for a system that can be easily picked up and moved to another hive. Testing proved positive, with a regular read range of up to 5 ft through the 1/4" wood model.



A photo of the whole solution setup during testing

Continued testing will include penetration with internal noise, different build materials, and other environments.



RFID The operates within powered RFID tags.

Credit: SparkFun [3]



Antenna

linearly The ability reader assistant to interpreted.



**RFID** (Radio reader.

- users to interpret

[1] S.G. Potts et al. "Global pollinator declines: trends, impacts and drivers," *Trends in Ecology & Evolution* 

- [2] www.wikipedia.com
- [3] www.sparkfun.com

# SYSTEM DESIGN



• Adding a secondary cooling mechanism would keep the reader module temperature low

REFERENCES

We would like to thank Undergraduate Research Center for funding our project as well as our Junior Design professor, Dr.

We would like to thank Maker Space of Mankato for providing the tools necessary to construct our bee box replica and Cholik Signs for providing the decals for our bee box replica.

## **CONTACT INFORMATION**

to contact us at Derek.Boes@mnsu.edu, Feel tree Wesley.Thompson@mnsu.edu and Nicholas.Madge@mnsu.edu with any questions or comments.



Disconnected	onnect 🔰 📑 🌡 0°C	Å <b>?</b>	JADAK
EPC User Memory Lock Tag	Untraceable Authenticate		
TimeStamp(msec)	RSSI(dBm)	ReadCount	Connect
			Reader Type: ® srial Network Custom Transport   Reader Name: Communications Port (CDM1) Image: Communications Port (CDM1)   Image: Transport Logs: Refresh Connect   Baud Rate: Select Region: Connect   Load/Save Profile Save Save Save   Performance Tuning Performance Metrics Display Options Satus/Version Info   Pregulatory Testing Firmmane/License Update Data Extensions
	Conversion to 2019 IADAK	a business unit of Novanta Corp	unation All Richts Resource

URA (Universal Reader Assistant)

Universal Reader Assistant is used to gather and extrapolate data from the RFID tags. The URA provides distances that can further be interpreted to get an accurate depiction of the bees precise

The **RFID** reader houses all the components. This is where the **USB-to-serial** connection pins are located, allowing for communication with the host computer interface.

The RFID reader also contains the RFID reader module, a microcontroller, a connection port for external antennae, and an external battery port. Although it is possible to power the RFID using the USB power only, a steady supply of 3.7V external power allows for further read range

### ACKNOWLEDGEMENTS