

## Machine Learning Based Smart Beehive Monitoring System Without Internet

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**Abstract :** Beekeeping plays essential role both in terms of agricultural yields and agricultural economy; they produce honey, wax, royal jelly, apitoxin, pollen, and propolis. Nowadays, these natural products become more importantly suitable and preferable for nutrition, food supplement, medicine, and industry. However, to produce organic honey, majority of the apiaries are located in remote or distant rural areas where utilities such as electricity and Internet network are not available. Additionally, due to colony failures, world honey production decreases year by year despite the increase in the number of beehives. The objective of this paper is to develop a smart beehive monitoring system for apiaries including those that do not have access to Internet network. In this context, temperature and humidity inside the beehive, and ambient temperature were measured with RFID sensors. Control center, where all sensor data was sent and stored at, has a GSM module used to warn the beekeeper via SMS when an anomaly is detected. Simultaneously, using the collected data, an unsupervised machine learning algorithm is used for detecting anomalies and calibrating the warning system. The results show that the smart beehive monitoring system can detect fatal anomalies up to 4 weeks prior to colony loss.

**Keywords :** beekeeping, smart systems, machine learning, anomaly detection, apiculture

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