



Fight The Mites To Save The Bees

Team **BeCure**

FIGHT THE MITES TO SAVE THE BEES

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01 The Problem

Bees are responsible for pollinating over 75% of global crops. Unfortunately, our precious honeybees have experienced **Colony Collapse Disorder (CCD)** at multiple beekeeping sites. This collapse is largely caused by factors such as viruses, pesticides, and most significantly, **Varroa Mites**. Furthermore, recent studies suggest that **if the temperature increases by 2 to 3°C**, the annual population of Varroa Mites could **increase** by approximately **1.5 to 2 times**. This implies that **climate change could further accelerate the occurrence of CCD**.

The life cycle of varroa mites are highly aligned to that of honeybees

Harms Experienced by Honeybees

Varroa mites live on the bodies of honey bees and feed on their **haemolymph**

Phoretic Phase



Varroa mites reproduce exclusively in the capped cells of **developing bee pupae**

Reproductive Phase



Reduced Lifespan

Decreased Survivorship

Weight Loss

Transmission of Viral Diseases



01 The Problem

The Current World's Way of Solving the Problem, and its Evident Downfall...



Currently, this collapse is being kept in balance through constant observation, surveillance, and judgement by the beekeepers. However, relying on **eye-balling** these tiny ticks can result in **inaccurate judgements, with an accuracy rate of only 30% to 50%**

And its Clear Impact to Food Security



35% of our food would not be as accessible, available or even around without bees to pollinate them” - WWF-

The reduction in pollination activity due to Varroa Mite can lead to a **15%~30% decrease in yields of major crops**. The **global economic loss** resulting from the decline in bee pollination is estimated to range from **\$23.5 billion to \$57.7 billion annually**

02 Our Solution: BeCure

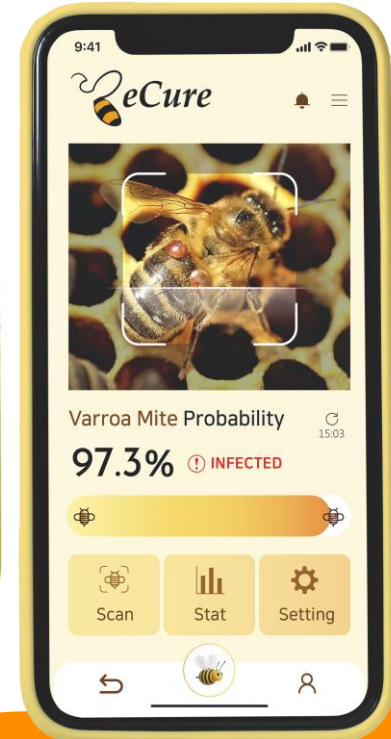


BeCure shifts the current paradigm of detecting varroa mites, utilizing **YOLO** algorithm in computer vision technology to quickly and effectively!!

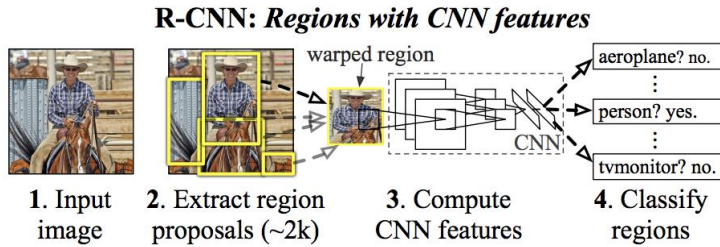
Just use a camera on your phone!!

By using computer vision technology, Varroa mite can be detected immediately with **BeCure**. This solution can be provided to beekeepers, agricultural enterprises, and governmental agricultural departments **worldwide**.

Furthermore, the system is regionally adaptable, **leveraging data** that can be applied across various locations and contexts, ensuring accessibility and utility at anytime.



02 The Algorithm



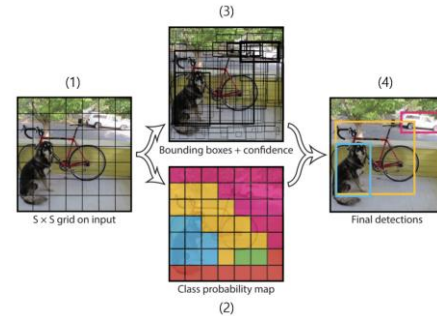
2-Stage Detector: R-CNN

- several processes are performed, such as obtaining parts of the image in advance where objects may be located and extracting features using a convolution net
- higher accuracy than YOLO, but complicated and slow

VS



's Pick

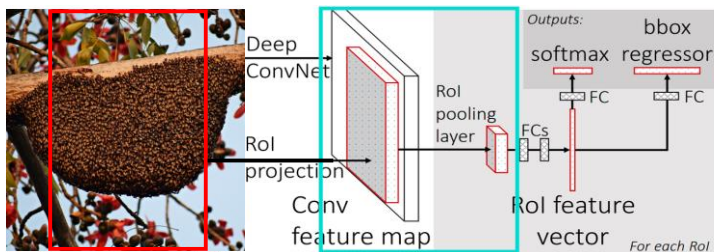


1-Stage Detector: YOLO

- **simplifies** these various steps of R-CNN into **one step**, using single stage detector
- Faster than Faster R-CNN, **detects object in real time**

02 The Algorithm (Full-Scale Description)

Step 1. Construct Dataset

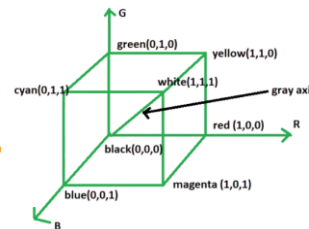


Extract a pixel-sized region of interest (ROI) from the bee macro photography image containing bee mites

Step 2. Label Data and Conduct Learning

7 Data Labels

- Bee mites
 - Bees infected with bee mites
 - Bees with deformed wings
 - Normal bees
 - Disease-infected larvae
 - Normal larvae
 - Fire extinguishers (honeycombs)
- Transform to RGB color model and conduct machine learning



Step 3. Classify to Three Categories

Normal	Risk	Infected
		

Analyzed Data
Sent to
in Real Time



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02 Our Solution: BeCure

With more than **45% increased accuracy**, we can now **prevent the transmission of Varroa Mites earlier on, significantly reducing the harm** they inflict upon honeybee population

Some studies indicate that **early detection** and effective control of Varroa Mite can maintain colony **survival rates at up to 85%**. This is a **significant improvement compared to survival rates below 30%** when proper control measures are not implemented.**

By eradicating Varroa Mite early and enhancing bee survival, **global agricultural yields could potentially increase by up to 20%*****

** *Rosenkranz, P., Aumeier, P., & Ziegelmann, B. (2010) Ecological Economics*
Dainat, B., et al. (2012). Predictive markers of honey bee colony collapse.

*** *Gallai, N., et al. (2009). Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics*

95.5%* Accuracy

BeCure's Tested Apiaries



Sample #1 Sunwoo Apiary



Sample #2 Somang Apiary



Sample #3 JS Apiary

*As a result of testing and detection of bee mites at **three** apiary samples in Paju City, South Korea

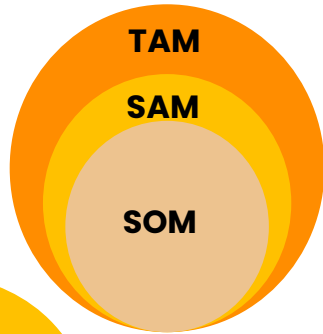
*Averaged out number of Accuracy

03 Scale of Our Impact



Impact Sizing through TAM-SAM-SOM Analysis

BeCure has the potential to address market of USD 810 million, with the most conservative target penetration rate. **Cooperation with non-governmental organizations and related international institutions** would lead to an increasing penetration rate, and a larger addressable market, which means, bigger impact!



TAM (Total Addressable Market)

International Apiculture Market Size:
USD 11.15 billion

SAM (Service Available Market)

$SAM = (TAM) * (\text{Regions Affected by Varroa Mites})$
USD 11.15 billion * 71% = USD 8.16 billion

SOM (Serviceable Obtainable Market)

$SOM = (SAM) \times (\text{Penetration Rate of BeCure})$
Initial penetration rate of BeCure: 1%
USD 8.16 billion x 1% = **USD 810 million**

Save up to...

\$47 Billion*

Economic Benefit Worldwide

*The contribution of honeybee pollination to agricultural production is valued at approximately \$235 billion annually. If Varroa Mite management leads to an increase in bee populations, it is projected that agricultural productivity could rise by up to 20%. - Gallai, N., et al. (2009). *Ecological Economics*

19%***

Global Food Security Problems related to improper pollination resolved by



**Estimated by: 35% (international food security problems related to improper pollination of bees)

*55% (Enhanced Survival Rate of Bees due to BeCure: 85%-30%) = 19%



03

Team BeCure

Fight the Mites to Save the Bees

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