SESSION 5 [CADAT]

Beehive Monitoring Based on IoT Technologies and AI

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- Components
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INTRODUCTION

Problem

Apiculture

Climate change
Chemicals in the agriculture
Pollution
Water scarcity
Parasites

Need monitoring technologies to assess the status of the beehive

INTRODUCTION

Related Work

Existing monitoring systems:

Temperature, humidity, weight, CO^2, video and audio

Self-Powered Smart Beehive Monitoring based on IoT

Data stoder in servers

Some proposals used video and Edge AI to recognize varroa

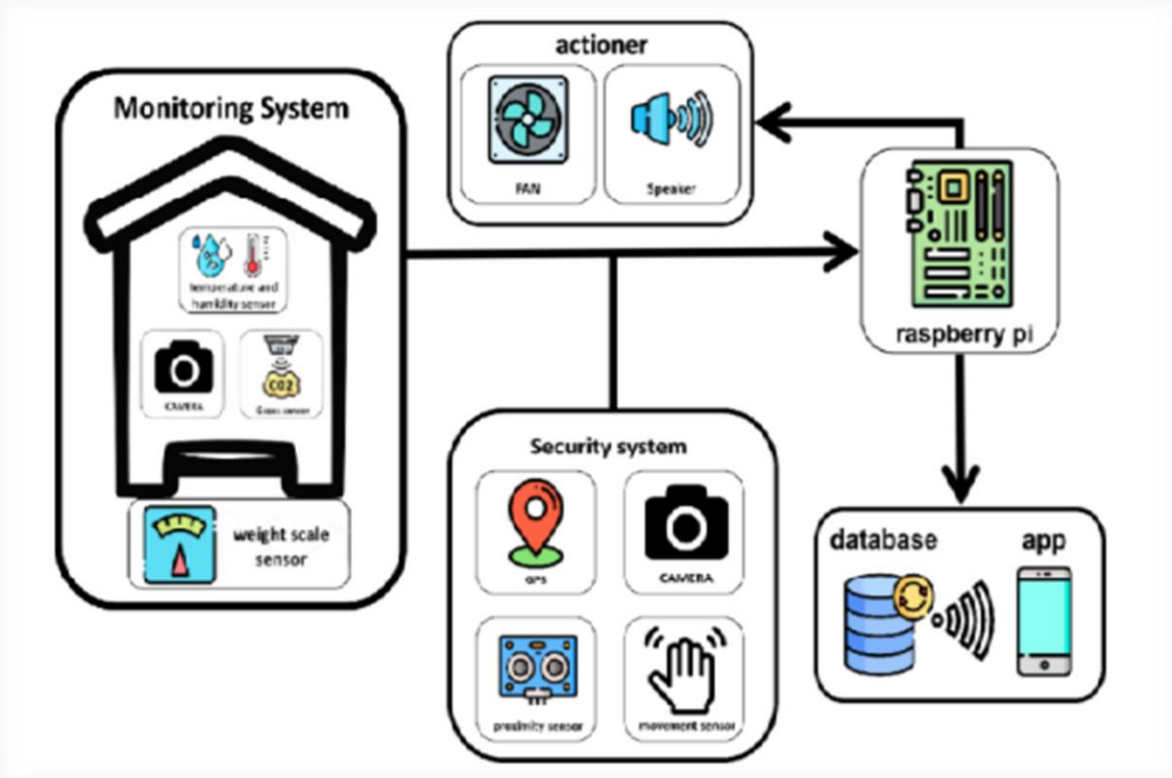
INTRODUCTION

Objective

Monitor the conditions in the beehive as part of a system for its protection based on AI including WiFi connection with cameras and speakers…

PROPOSAL

Architecture



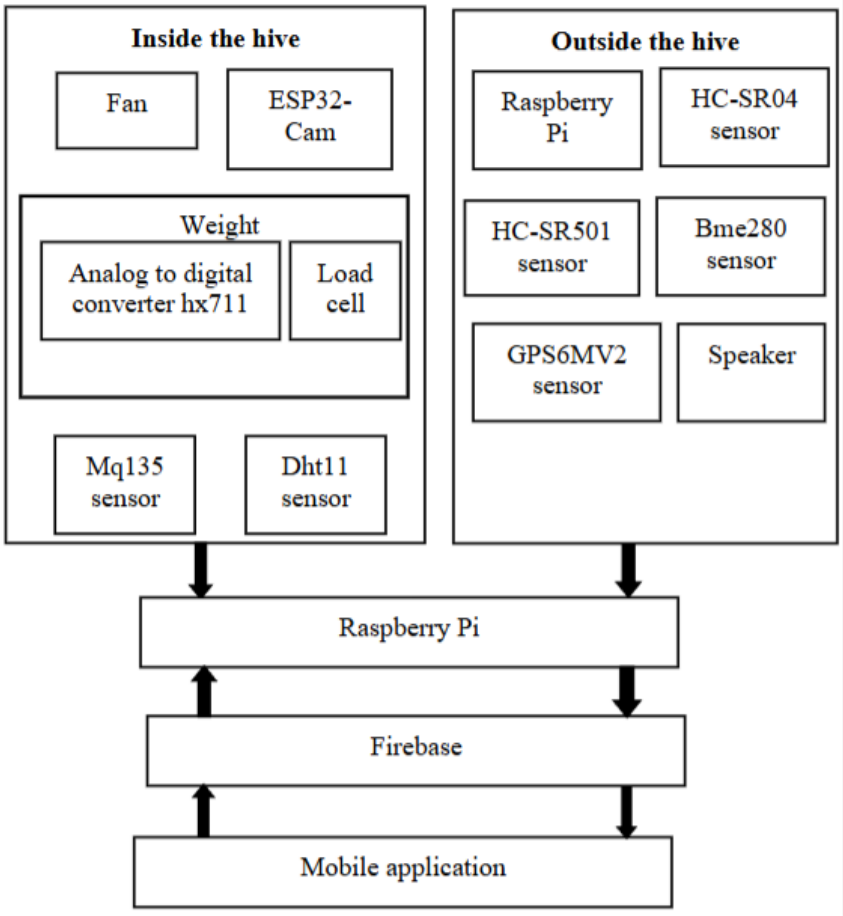
PROPOSAL

Components

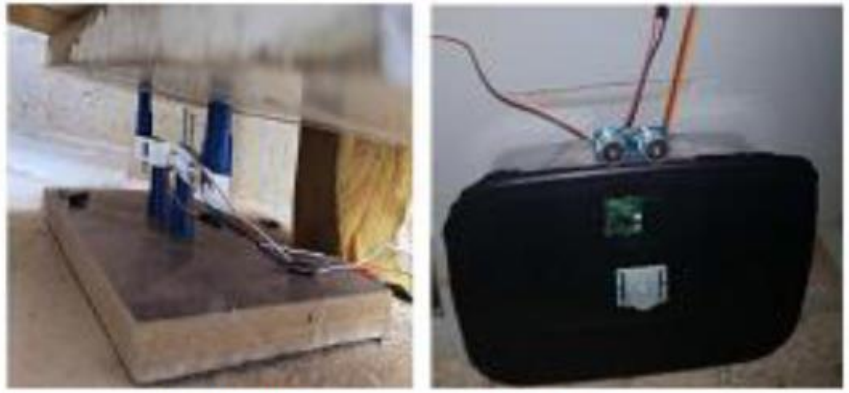
- Raspberry PiRaspberry
- BME280 (pressures)
- DHT11 (temp. and humidity)
- MQ135 (CO^2)
- HC-SR04 (ultrasound sensor – proximity)
- Raspberry Pi Camera V2

PROPOSAL

Components



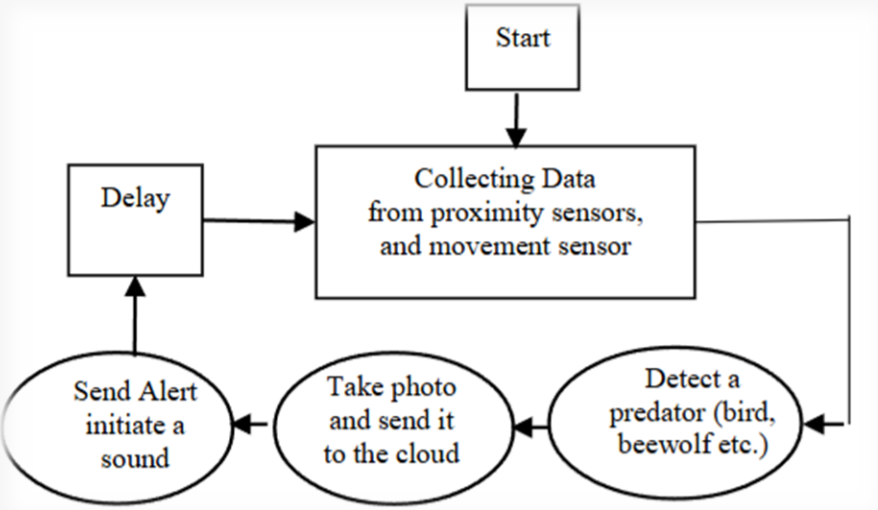
(a) Beehive External and Internal components.

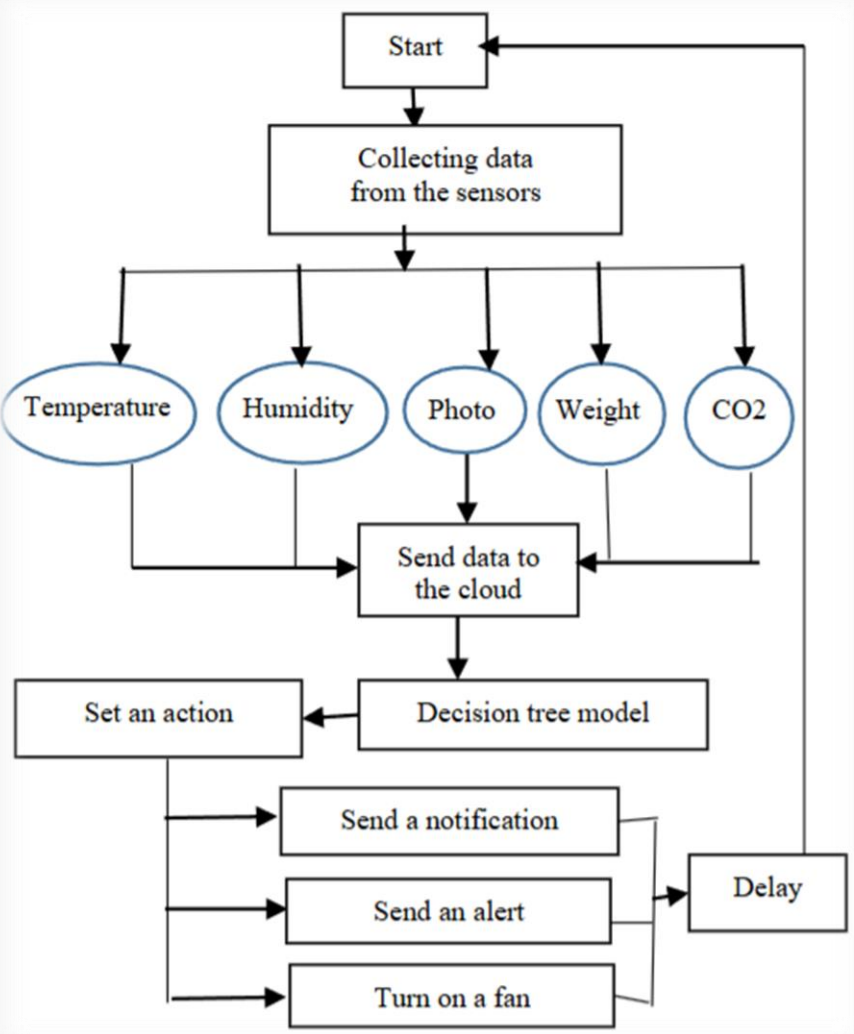


(b) Weight sensor. c) Security sensors.

PROPOSAL

Modules





RESULTS

Collected data

Date/Time	Interior temp. (°C)	Exterior temp. (°C)	Rain falls	CO2 (ppm)	Humidity (%)	Wight (Kg)	Pressure (Pa)
08/03/2023 22:38	24.5	27.2	false	490.06	70	15	930.6
26/04/2023 16:53	25.0	28.0	false	498.21	80	18	925.6
27/04/2023 00:55	30.2	31.0	false	506.35	60	12	927.1
29/05/2023 17:07	37.0	38.1	true	538.94	34	11.5	930.1
10/06/2023 15:10	33.0	40.4	false	506.35	32	11.4	933.7

RESULTS

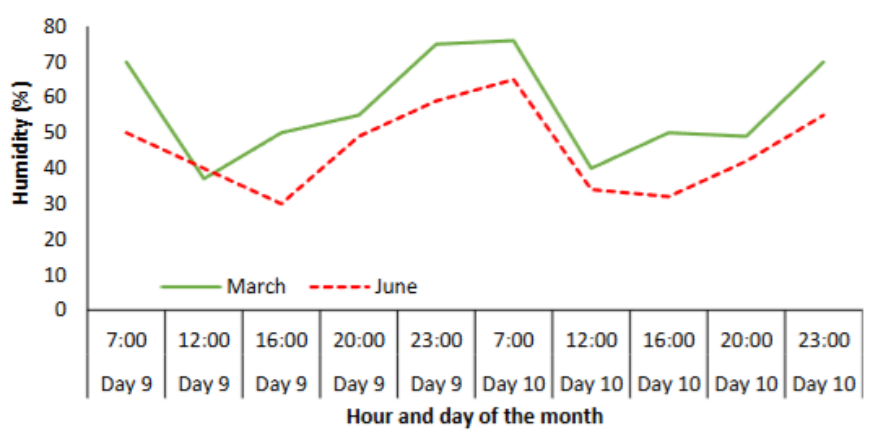
Desition tree model

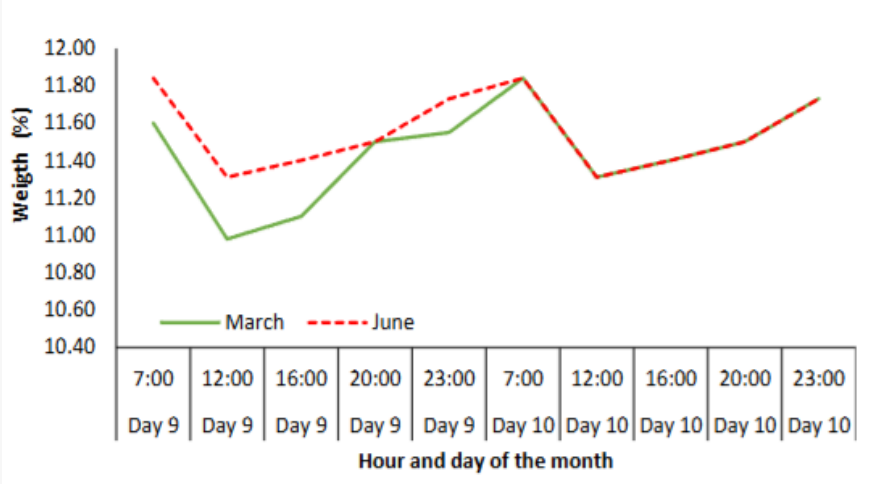
Metrics	Metric value (%)
F1 Score	88.5
Recall	88.3
Accuracy	90.2

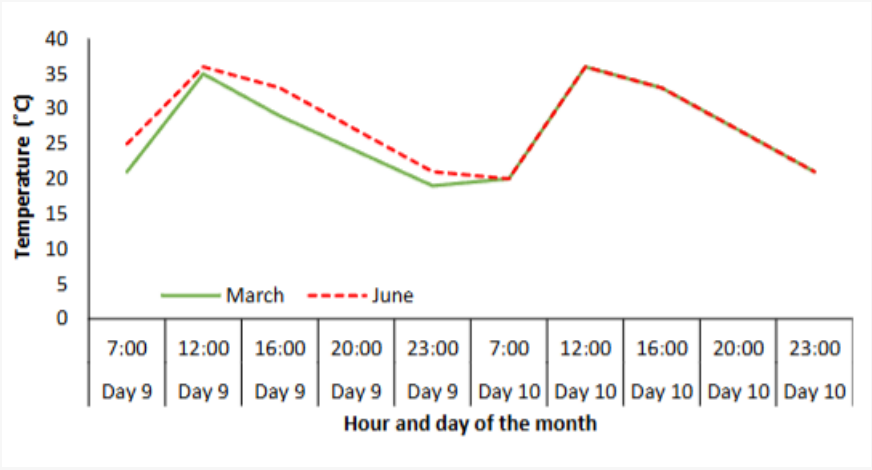
Example	Attributes						Result			
	Humidity %RH	Exterior Temp. C°	Interior Temp. C°	Weight Kg	Co2 ppm	Rainfall in last 24h	Send Notification	Send Alert	Requires hive visit	Class
1	70 -95	9- 47	10- 36	1- 35	440-500	N	N	N	N	Normal
2	70 -95	<8	10- 36	1- 35	440-500	N	Y	N	N	Hibemation
3	>96	9- 47	10- 36	1- 35	440-500	N	Y	N	N	Evaporating Nectar
4	0 -70	9- 35	10- 36	1- 35	440-500	N	Y	N	N	Low humidity hive
5	60-85	9- 35	10- 36	1- 35	440-500	N	N	Y	Y	Colony no longer in hive
6	70 -95	9- 35	10- 36	1-35	400-440	N	N	Y	Y	Diminished population - Reduced C02 production
7	70 -95	9- 47	>38	1-35	440-500	N	N	Y	Y	Hive is too hot
8	>96	2- 47	10- 36	1-35	440-500	Y	N	Y	Y	Hive is too damp
9	0- 100	9- 47	10- 36	>'5	440-500	N	Y	N	N	Hive is too heavy

RESULTS

Visualization







CONCLUSIONS

Growing importance of IoT andAI technologies in monitoring beehives in the Sahara region in southwestern Algeria.

Innovative solutions to monitor the health status of the hive and protect the bees from predators such as bee-eating birds, diseases like varroa, and theft.

Our future work will provide more details on the results of experiments related to hive security, namely the detection of predators and diseases affecting bee colonies, besides the study of other parameters like bee sounds, and bee behavior based on Artificial Intelligence and Internet of Things technologies..

THANK YOU FOR YOUR ATTENTION

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