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New Technologies in Health Sustainability in Vulnerable Areas Inspired by the Qualities of Bees

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Abstract---The distribution of medicines in rural, isolated, or disaster-affected areas represents one of the logistical challenges facing healthcare systems. In response to this problem, an initiative based on the development of bee-inspired drones is proposed. The objective is to create an efficient, autonomous, and sustainable medical transport network within the healthcare system. Methodologies used included a literature review, qualitative analysis, and deductive research. The results show that these medical pollinating drones will combine advanced technology with biological design principles, offering an innovative solution to improve access to vital treatments and supplies
Keywords---artificial intelligence, drones, IoT, sustainable medicine.

Introduction

Bees are recognized for their valuable contribution to humans, presenting different qualities, including crop pollination (García et al., 2016), and are also recognized for their precise navigation (Educación, 2025) and collaborative work. These qualities are technologically replicable using light, autonomous, and coordinated drones ([Controlled Flight of a Biologically Inspired Insect-Scale Robot, 2025](#)), capable of transporting small loads over short and medium distances. Using this type of unmanned vehicle would allow for rapid delivery of medicines in areas without vehicular access, in emergencies, or where conventional response times are insufficient.

In recent years, technological innovation has sought creative solutions to improve access to medicines in rural and hard-to-reach areas. One of the most fascinating proposals is the use of bees as "natural drones" for the transport and distribution of medicines. Inspired by these insects' efficiency and precision in pollination, researchers have explored how to leverage their flight and orientation capabilities to deliver small payloads, such as medicines, to remote communities.

According to recent studies, bees can be trained to associate certain odors with rewards, allowing them to be guided to specific delivery points ([Smith et al., 2022](#)). Furthermore, their size and autonomy make them a sustainable and low-cost alternative to technological drones, especially in areas with limited infrastructure. This idea not only promises to revolutionize medical logistics but also highlights the crucial role of bees in ecological balance and their potential to contribute to human well-being.

Materials and Methods

Deductive research was used based on a literature review on the inspiration for the use of drones and artificial intelligence to achieve the objective. IoT (Internet of Things) technology was considered to ensure the project's sustainability. The inductive-deductive method was used with a qualitative approach

Analysis and Discussion of the Results

In recent years, advances in automation and biomimicry have driven the design of new technologies inspired by natural organisms. One of the most fascinating examples is the development of lightweight drones that mimic the behavior and structure of bees. These were designed to fly with agility and precision in confined spaces, often mimicking characteristics such as wing flapping, autonomous navigation, and the ability to work in swarms.

The interest in trying to simulate the intelligence of bees is not accidental because they are insects that show energy efficiency and exceptional maneuverability, making them an ideal model for tasks in complex environments, such as rescue missions, environmental monitoring, infrastructure inspection, or even artificial pollination (Montilla et al., 2021); furthermore, their small size and light weight make drones inspired by them safe, versatile, and suitable for operating in sensitive environments.

Thanks to advances in lightweight materials, miniaturized sensors, and adaptive control systems, biomimetic drones are reaching previously unimaginable levels of autonomy and functionality. This type of technology represents a significant step toward creating more efficient, sustainable, and environmentally friendly robotic systems (Wang et al., 2021).

For the development of the work, some methodologies developed by some authors were considered where they have worked on drones that simulate the work of bees, some worked on a four-wing microrobot that improves stability and control compared to two-wing models and how these are developed other research related to the use of the qualities of bees to be used as drones that solve social problems in very difficult to access places.

The design and construction of lightweight drones can perform a variety of tasks, with the fundamental objective of simulating insect-like drones that do not interfere with the environment. Figure 1 shows some of these characteristics, along with the dynamics of bees.

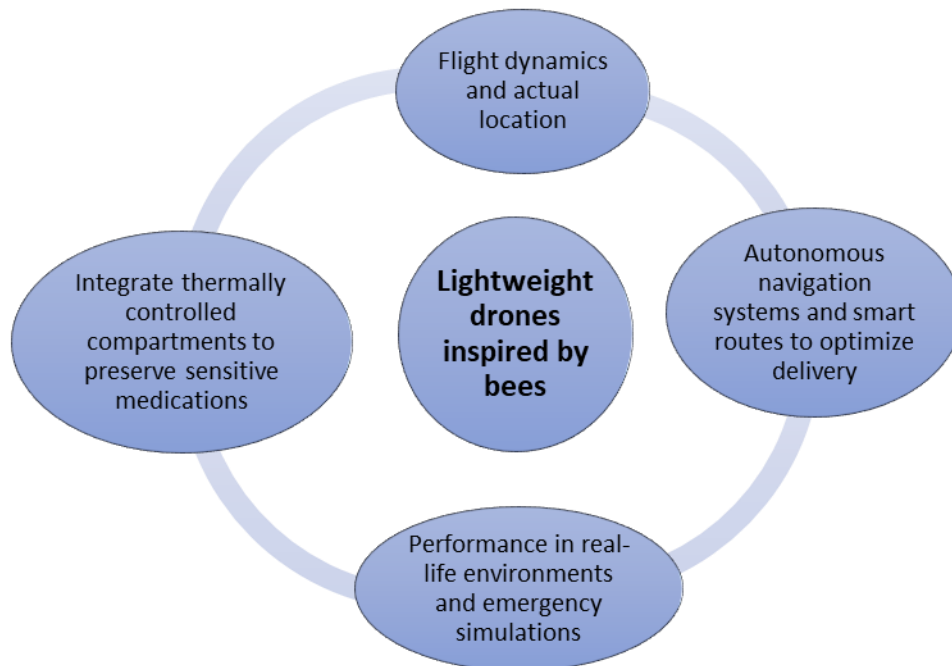


Figure 1. Characteristics of light drones considering bee dynamics

As observed, light drones inspired by birds and bees present different advantages, we can talk about the flight dynamics and real location, these allow the ability of these to maintain or return to a specific flight condition after

being disturbed (Fan et al., 2024). These drones can maintain autonomous navigation systems, which allows them to take intelligent routes to carry out their activities, all of which allows them to have good performance in real environments and many cases in emergency simulations. In this context, they integrate thermally controlled compartments to preserve sensitive medications.

Proposed Technical Characteristics

The idea is to achieve a compact design with biodegradable and ultralight materials, allowing the creation of silent and efficient propellers to minimize environmental impact. In this sense, artificial intelligence is proposed for autonomous route decisions and obstacle avoidance, in addition to the real-time communication module for cargo tracking and monitoring, where a system for docking and safely releasing medicines will be available.

Expected impact

The implementation of this technology will strengthen primary care networks, reduce critical delivery times, and save lives in situations where every minute counts. Furthermore, it can serve as a model for technological innovation with a biomimetic approach. This discipline studies nature to imitate its designs and processes in order to solve human problems and create innovative solutions (Cocom & González, 2015), promoting the development of sustainable and adaptable solutions in other sectors such as agriculture and logistics.

Conclusions

The implementation of bee-inspired drone technology can enable the creation of an efficient, autonomous, and sustainable medical transport network within the healthcare system. A literature review was used as a methodology, revealing that these primary care networks designed with these types of drones can reduce critical delivery times and save lives in situations where every minute counts. Furthermore, it can serve as a model for technological innovation with a biomimetic approach, driving the development of sustainable and adaptable solutions in other sectors such as agriculture and logistics

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