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Apiculturists' issues and challenges: a basis for invoking IT model in beekeeping industry

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Abstract. The most significant activity of honey bees, as far as advantages to people, is their pollination of natural vegetation. Bees and other pollinators seem to be declining globally. Beekeeping in the Philippines is a thriving industry that perfectly matches the natural landscape of the country. The goal of this study was to define the challenges and issues of Apiculturists in the Philippines where-in an IT approach was formulated to address these issues. Up to now, there is no initiative Information Technology approach in the beekeeping industry in the Philippines. Design thinking has been used as methodology in this study. Several challenges and issues were determined, and it is stated that the main problem to be addressed in order for the bee colonies to have a longer lifespan is its Apiary Location, an IT solution via Drone Technology with a Computer Vision approach was proposed named as Apiary Locator. A proposed framework of the Apiary Locator has been prepared. It is then recommended for the Apiary Locator to be developed as it shall benefit the apiculturists of the Philippines. Also, it will be a basis for developing IT solutions for the Beekeeping industry.

1. Introduction

One bite in in three of the sustenance you eat specifically or indirectly relies upon fertilization by honey bees. The most significant activity of honey bees, as far as advantages to people, is their pollination of natural vegetation. In calm atmospheres, most woodland trees are wind-pollinated, however numerous sorts of shrubs, little trees, and herbaceous plants, including numerous wildflowers, are honey bee pollinated. Protection of numerous habitats thus relies on the conservation of honey bee populaces, for if the honey bees vanish, proliferation of huge components of the vegetation might be seriously scarced [1].

The wonders of Honey Bees and its advantages to humanity but with its declining in production triggered the author to conduct this study so as to heighten the production as well as to save the bees. The study is also vertically aligned towards the Sustainable Development Goals of the United Nations specifically Goal 12: Responsible Consumption and Production [2].

Up to now, there is no initiative Information Technology approach in the beekeeping industry in the Philippines. This is the initial phase of creating a well-needed technology for the beekeeping industry in the country.

The goal of this study was to define the challenges and issues of Apiculturists in the Philippines where-in an IT approach shall be developed to address these challenges and issues.

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2. Beekeeping Status Quo

Beekeeping is a well-paid trade even utilizing straightforward management strategies techniques however needs to think about nearby culture and economy for it to be fruitful. Beekeeping as an enterprise fits in exceptionally well with little scale ranchers' occupations. It isn't intrusive; honey bees work along the common examples of nearby agro-environmental zones and give beneficial outcomes to the fauna and verdure found inside [3].

Honey bees and different pollinators – both common and managed – appear to decrease all around, especially in North America and Europe. The nonattendance of energetic provincial or universal ventures expected to screen the present status and examples of pollinators suggests there is a noteworthy powerlessness in the scale and level of this decrease [4].

Concern over the pollinator declines followed by the sudden disappearance of honey bee colonies is well documented in North America and Europe. The dramatic decline in by and large pollinator populaces is a fundamental issue for agribusiness production [5].

"The Food and Agriculture Organisation of the United Nations (FAO) estimates that out of some 100 crop species which provide 90% of food worldwide, 71 of these are bee-pollinated. In Europe alone, 84% of the 264 crop species are animal pollinated, and 4 000 vegetable varieties exist thanks to pollination by bees." – UNEP, 2010 Beekeepers first sounded the caution about vanishing honey bees in the United States in 2006. Apparently solid honey bees were simply forsaking their hives as once huge mob, never to return [6]. The known misfortunes alone are striking. Honey bee colony mortality in Europe has arrived at the midpoint of around 20% (with an extensive variety of 1.8% to 53% between nations) [4].

Beekeeping in the Philippines is a thriving industry that perfectly matches the natural landscape of the country. All types of honey bees utilized for beekeeping exist in the Philippines. These are the European bumble bees (Apis mellifera), Asian bumble bees (Apis Cerana), and stingless honey bees (Trigona spp.).Queen quality, biological conditions, flower arrangement, sorts of innovation and asset administration are among the noteworthy elements influencing the benefit of beekeeping enterprises. In addition, colony quality, kinds of hives utilized, the age of the queen, swarming of colonies and bumble bee management hones are additionally central point affecting the productivity of beekeeping organizations. The two essential difficulties of beekeeping in the Philippines are the absence of nature of Apis mellifera and varroa bugs pervasion. Apis mellifera queens are transported in by thousands consistently from USA and Australia. Medications for varroa vermin are expensive and have a tendency to inoculate the parasites following a couple of years. The National Apiculture Research Training and Development Institute (NARTDI) together with the University of the Philippines Bee Program have just conceived an approach to limit, if not take out these difficulties by utilizing queen instrumental insemination innovation. Through this innovation, queens will be accessible all year in the nation. This innovation will likewise deliver honey bees impervious to varroa vermin invasion. In any case, the essential test is government's nonappearance of assistance for beekeeping progression contrasted with developed countries; their legislatures are at the front line of beekeeping attempts. The world supply of pure honey is declining. China, a noteworthy provider of bumble bee items, is restricted from trading to USA and other European nations since its honey bee items are debased with prohibited antibiotics. This would be an open door for the Philippines to fill the void caused by this ban. The Philippines is in the situation to pitch natural honey bee items to the world market.

Several challenges pose a threat to the industry such as climate change that severely affects the health of bees, entry of fake and adulterated honey, and competition from imported bee products. Further, the difficulty of beekeepers in the evaluation, status monitoring, communication, and inventory has affected the efficiency of honey production. The need to increase production requires training for more beekeepers and funding from the government. The magnitude for the beekeeping industry provides a tremendous market opportunity for beekeeping technology to be introduced, grow, and develop. In the Philippines, particularly in the region, no apiary uses this any kind of technology in their operation. Thus demand for such technology will be advantageous.

3. Methodology

The author used Design Thinking as an innovative approach in this study.

Establishments and associations must advance in response to the rivalry and quickly changing business sector demands. For this intention, Design Thinking is seen as an unfaltering methodology for an extent of business challenges that should be looked for after by both designers and nondesigners [7]. Figure 1 illustrates the Design Thinking process.

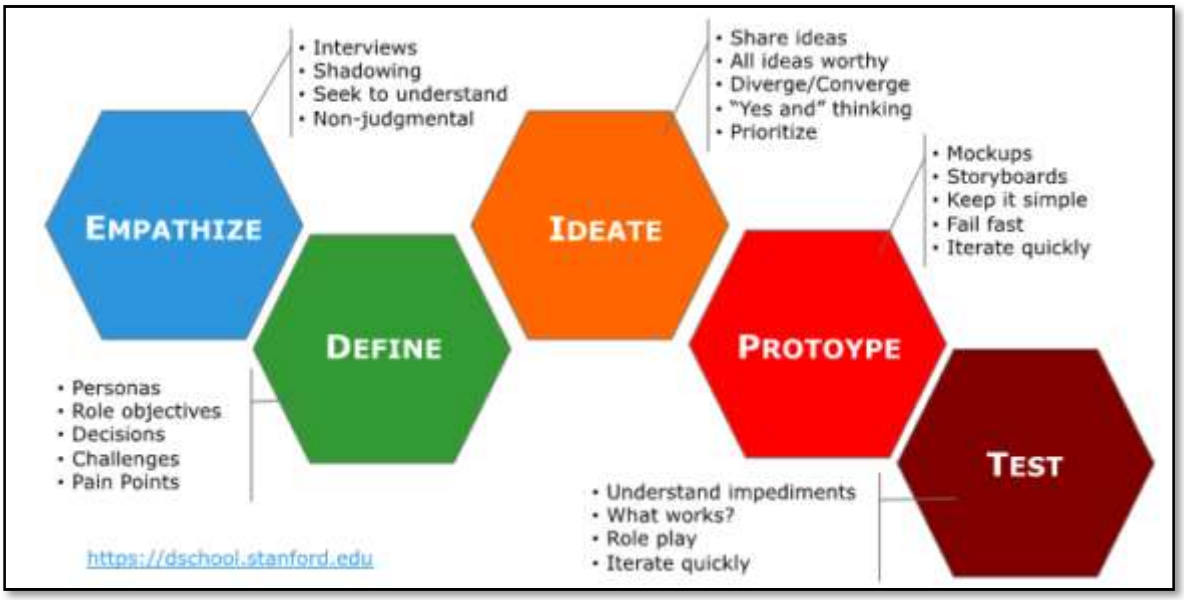

Figure 1. Design Thinking Process

3.1 Empathize.

The initial period of the Design Thinking process is to get an empathic cognizance of the issue you are endeavoring to determine. This incorporates advising experts to find more about the zone of worry through witnessing, drawing in and relating to understand their experiences and motivations, and furthermore submerging yourself in the physical condition to have a more significant individual appreciation of the issues included [8]. Empathy is the establishment of a human-focused outline process where you observe and connect with clients and submerge yourself to reveal their requirements [9].

Interview with various registered beekeepers and apiculturists has been conducted by the author at DMMMSU-NARTDI (Don Mariano Marcos Memorial State University - National Apiculture Research Training and Development Institute) [10].

3.2 Define.

Thru the Define stage, we set up together the data we have made and accumulated amid the Empathize stage. We will break down the perceptions and incorporate them so as to characterize the center issues that have been recognized as yet [8]. The define mode is the point at which you unload and incorporate your empathy findings into convincing needs and bits of knowledge, and degree a particular and vital challenge. It's critical to the design process since it unequivocally communicates the issue you are endeavoring to address through your endeavors [11].

Based on the interview conducted during the first stage of Design Thinking, a persona with the name Condoriano has been established. In this study, Condoriano represents the Beekeepers and Apiculturists in the Philippines. Condoriano's problems in beekeeping are listed as the difficulty of hive evaluation, the difficulty of hive status monitoring, the difficulty of communication between beekeepers, the difficulty of inventory, the difficulty of locating healthy habitat. As emphasized by Condoriano, his main problem is on how to locate a healthy habitat wherein he can deploy his apiary. The apiary must be at

least 100 meters away from the forest where-in the bees would harvest their nectar. This study focuses on addressing that problem.

3.3 Ideate.

Ideate is the technique for your strategy in which you mean to create radical outline options. Objectively it addresses a strategy of "going wide" in regards to thoughts and results – it is a technique of "flaring" instead of "focus" [9].

Ideas were discussed with the registered beekeepers and apiculturists through focus-group. It is then conferred that the idea in using Drone Technology (Unmanned Aerial Systems - UAS) in scouting a land area is a more feasible solution to the problem hence it would give real-time results of the land survey. And with the data given by the UAS, this will produce a more accurate Apiary location.

3.4 Prototype.

Prototyping is getting thoughts and investigations out of your head and into the physical world [11].

Computer Vision will be adapted. Support vector machines or SVM is a broadly utilized method in supervised learning. Including a non-probabilistic binary linear classifier, SVM is appropriate for characterizing labeled images in computer vision. Additionally, as an essential image processing technique, adaptive thresholding is extensively applied to edge detection, which is extremely helpful in evaluating land textures. The prototype will be implemented in Python and leverages the OpenCV library [11].

3.5 Test.

Designers or evaluators carefully test the entire item utilizing the finest arrangements distinguished amid the prototyping stage. Last stage of the 5-stage model, in any case, in an iterative procedure, the outcomes produced amid the testing stage are frequently used to rethink at least one issues and advise the comprehension of the clients, the states of utilization, how individuals think, behave, and feel, and to empathise. Notwithstanding amid this stage, modifications and refinements are made so as to preclude issue solutions and determine as profound comprehension of the item and its clients as would be prudent [8].

4. Findings

After numerous interviews to beekeepers and apiculturists, the challenges and issues of Condoriano are summarized as follows. (1) Difficulty of hive evaluation. Condoriano still uses a paper-based method in recording and evaluating each hive. (2) Difficulty of hive status monitoring. Condoriano must visit the apiary and inspect each Hive too often wherein he is losing too much time. (3) Difficulty of communication between beekeepers. During dearth times, the drought of honey, honey or sugar should be supplied to the colony. When this happens, Condoriano should be able to contact the nearest beekeeper in order to ask for a colony rescue. (4) Difficulty of inventory. Where-in Condoriano is still using the traditional paper-based method in recording data. Written notes often get lost or become unreadable. (5) Difficulty of locating a healthy apiary habitat. The location is suitable for beekeeping if the vegetation provides ample sources of nectar and pollen. Also, the location should be at least 100 meters away from the forest. Condoriano is having a hard time in evaluating areas all by himself because he should scout the area manually. Another, there are areas for evaluation that Condoriano cannot reach via human-foot like mountain areas. Condoriano's problems in beekeeping are listed in Figure 2.

Condoriano has given emphasis that his main problem is number 5, difficulty of locating a good apiary location. For, an excellent location is one in which forage is abundant throughout the year. Also, high areas are hard to reach, roads to an area may also be rough and may not be accessible. Hence, a proposed IT solution that may be seen in Figure 3 has been prepared.

Phase 1 would let Condoriano capture a real-time image of the current condition of the target location. While on Phase two, the image will be evaluated according to the characteristics of a healthy

apiary location, e.g. sources of nectar and pollen. Lastly, findings will display the location that is best suited for the Apiary.

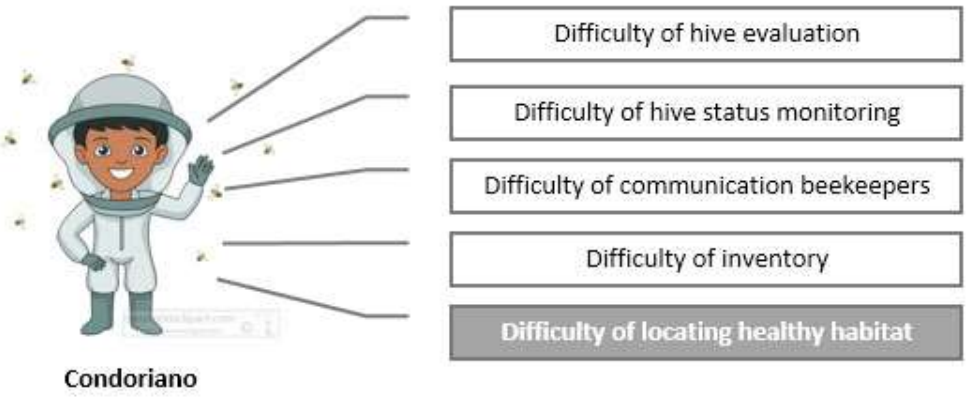

Figure 2. Persona of a beekeeper

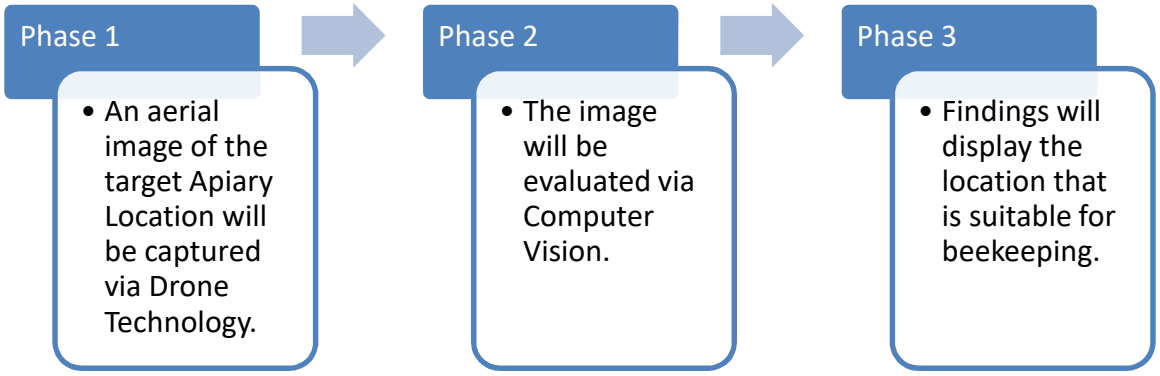

Figure 3. Proposed Framework of the Apiary Locator.

5. Conclusions and Recommendations.

As a result of this study, several challenges and issues were determined as Apiculturists has difficulties in hive evaluation, hive status monitoring, communication between apiculturists, inventory and locating a healthy apiary habitat.

It is mentioned that the main problem to be addressed in order for the bee colonies to have a longer lifespan is its Apiary Location. An excellent location is one in which forage is abundant throughout the year.

In order to address that main problem, a solution was formulated. It was then proposed to develop an IT Solution via Drone Technology with a Computer Vision approach. An Apiary Locator.

Thus, it is then recommended for the Apiary Locator to be developed as it will benefit the apiculturists of the Philippines. Also, it will be a basis for developing IT solutions for the Beekeeping industry further.

6. Future Works

In this study, using the Design Thinking methodology, the authors have reached the Ideate stage. Future researchers may use the proposed framework that can be seen in Figure 3 to address the main problem of Condoriano. The authors expect to complete the stages of the mentioned methodology in the continuance of this research since the primary purpose of this study is to provide an IT framework. Future researchers may continue through Prototype stage and Test stage based on this study.

As seen in Figure 2, there are other difficulties that Condoriano is facing which needs to have a solution. From this, future researchers may take this study to a broader benefit for Condoriano.

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