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Honey Adulteration using Machine Learning For CNN

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Abstract

This PyQt5 application is designed to classify different types of honey based on images provided by the user. The user interface allows the user to select an image and then click the "CLASSIFY" button to classify the type of honey shown in the image. Upon selecting an image, the application loads it and displays it in a designated area. When the "CLASSIFY" button is clicked, the application runs a pre-trained deep learning model stored in JSON and H5 files to predict the type of honey in the image. The model predicts whether the image contains one of four types of honey: "LEMON SYRUP HONEY," "PURE HONEY," "RICE SYRUP HONEY," or "SUGAR SYRUP HONEY." Depending on the predicted type of honey, the application performs additional analysis. For instance, if the predicted type is "LEMON SYRUP HONEY" or "RICE SYRUP HONEY," the application computes the percentage of red pixels in the image, likely indicative of adulteration, and displays this percentage along with the predicted type. Additionally, it uses a K-Nearest Neighbors classifier trained on a dataset to classify whether the honey is affected by a specific condition (lung cancer or tongue disease). If the predicted type is "PURE HONEY" or "SUGAR

SYRUP HONEY," no further analysis is conducted, and the application displays a percentage of zero for adulteration.

Keywords: Honey Adulteration, Pure Honey, Sugar Honey, Machine Learning, CNN.

1. Introduction

Honey, often referred to as "liquid gold" for its myriad health benefits and culinary versatility, has been cherished by civilizations for millennia. However, the integrity of this natural sweetener has come under scrutiny due to the widespread issue of adulteration. Adulteration, the deceptive practice of diluting pure honey with cheaper substitutes such as corn syrup or other sugars, not only compromises the quality and nutritional value of honey but also poses significant challenges to consumers, producers, and regulatory authorities worldwide. Traditional methods of detecting honey adulteration have proven to be labor-intensive, time-consuming, and often lack the sensitivity required to detect sophisticated adulteration techniques. In response to these challenges, the application of machine learning techniques has emerged as a promising approach for the rapid and accurate detection of honey adulteration. Machine learning, a branch of artificial intelligence, empowers computers to learn from data and make predictions or decisions without being explicitly programmed. By leveraging the vast amounts of data generated throughout the honey production and supply chain, machine learning algorithms can be trained to recognize patterns indicative of adulteration with remarkable precision. In this paper/presentation, we explore the application of machine learning in detecting honey adulteration, aiming to provide a comprehensive overview of the methodologies, challenges, and opportunities in this field. We will delve into the various types of honey adulteration, ranging from simple dilution with syrups to more sophisticated techniques such as ultrafiltration and chemical modification, and discuss how machine learning algorithms can effectively discern authentic honey from adulterated samples.

1.1. Artificial Intelligence

Artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans. Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is often used to describe machines (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving".

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. Some of the activities computers with artificial intelligence are designed for include:

- Speech recognition
- Learning
- Planning
- Problem solving

1.2. Definitions

Computer science defines AI research as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.[1] A more elaborate definition characterizes AI as “a system’s ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation

1.3. Ability to Manipulate and Move Objects

Knowledge engineering is a core part of AI research. Machines can often act and react like humans only if they have abundant information relating to the world. Artificial intelligence must have access to objects, categories, properties and relations between all of them to implement knowledge engineering. Initiating common sense, reasoning and problem-solving power in machines is a difficult and tedious task.

1.4. Basics

A typical AI analyzes its environment and takes actions that maximize its chance of success. An AI's intended utility function (or goal) can be simple ("1 if the AI wins a game of Go, 0 otherwise") or complex ("Do mathematically similar actions to the ones succeeded in the past"). Goals can be explicitly defined, or induced. If the AI is programmed for "reinforcement learning", goals can be implicitly induced by rewarding some types of behavior or punishing others. Alternatively, an evolutionary system can induce goals by using a "fitness function" to mutate and preferentially replicate high-scoring AI systems, similarly to how animals evolved to innately desire certain goals such as finding food. Some AI systems, such as nearest-neighbor, instead of reason by analogy, these systems are not generally given goals, except to the degree that goals are implicit in their training data. Such systems can still be benchmarked if the non-goal system is framed as a system whose "goal" is to successfully accomplish its narrow classification task.

Figure.1. Self-detection using AI

1.5. Challenges of AI

The overall research goal of artificial intelligence is to create technology that allows computers and machines to function in an intelligent manner. The general problem of simulating (or creating) intelligence has been broken down into sub-problems. These consist of particular traits or capabilities that researchers expect an intelligent system to display. The traits described below have received the most attention.

1.6. Reasoning, Problem Solving

Early researchers developed algorithms that imitated step-by-step reasoning that humans use when they solve puzzles or make logical deductions. By the late 1980s and 1990s, AI research had developed methods for dealing with uncertain or incomplete information, employing concepts from probability and economics.

1.8. Social Intelligence

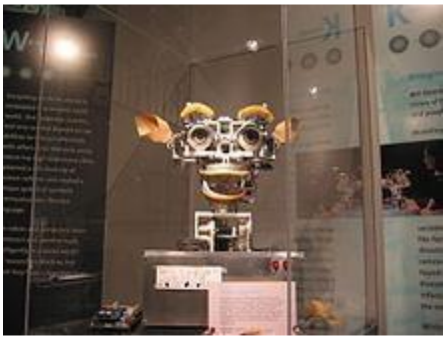

Figure.2. Kismet, a robot with rudimentary social skills

Moravec's paradox can be extended to many forms of social intelligence. Distributed multi-agent coordination of autonomous vehicles remains a difficult problem. Affective computing is an interdisciplinary umbrella that comprises systems which recognize, interpret, process, or simulate human affects. Moderate successes related to affective computing include textual sentiment analysis and, more recently, multimodal affect analysis (see multimodal sentiment analysis), wherein AI classifies the affects displayed by a videotaped subject.

1.9 GENERAL INTELLIGENCE

Historically, projects such as the Cyc knowledge base (1984–) and the massive Japanese Fifth Generation Computer Systems initiative (1982–1992) attempted to cover the breadth of human cognition. These early projects failed to escape the limitations of non-quantitative symbolic logic models and, in retrospect, greatly underestimated the difficulty of cross-domain AI. Nowadays, the vast majority of current AI researchers work instead on tractable "narrow AI" applications (such as medical diagnosis or automobile navigation). Many researchers predict that such "narrow AI" work in different individual domains will eventually be incorporated into a machine with artificial general intelligence (AGI), combining most of the narrow skills mentioned in this article and at some point even exceeding human ability in most or all these areas. Many advances have general, cross-domain significance. One high-profile example is that Deep Mind in the 2010s developed a "generalized artificial intelligence" that could learn many diverse Atari games on its own, and later developed a variant of the system which succeeds at sequential learning. Besides transfer learning, hypothetical AGI breakthroughs could include the development of reflective architectures that can engage in decision-theoretic metareasoning, and figuring out how to "slurp up" a comprehensive knowledge base from the entire unstructured Web.

2. Existing System

The existing system introduces a novel approach utilizing the AgSiN/SU-8 layer integrated into a silver-based SPR structure for the detection of water content in stingless bee honey. Through experimentation, the adulteration of honey samples was conducted, revealing that the AgSiN/SU-8 layer effectively preserves the integrity of the silver metal, thereby minimizing erosion and reducing the formation of silver oxide. The resonance angles observed in adulterated honey solutions exhibited a consistent shift towards higher angles compared to pure honey solutions, indicating the AgSiN/SU-8 layer's capability to discern variations in water content percentage. Remarkably, after a 24-hour period, the Cr/Ag/AgSiN/SU-8 structure demonstrated minimal changes in minimum reflectivity, underscoring the protective function of the AgSiN/SU-8 layer in maintaining SPR characteristics. Additionally, the presence of the AgSiN/SU-8 layer was found to significantly decrease the oxygen atomic percentage by 21.48%, further mitigating silver oxide formation. This pioneering study not only highlights the efficacy of the AgSiN/SU-8 layer for water content detection in stingless bee honey but also underscores its dual role in safeguarding the silver surface from erosion and minimizing silver oxide formation.

3. Proposed System

The proposed system is a PyQt5-based graphical user interface designed for honey adulteration detection. It leverages a pre-trained convolutional neural network (CNN) model implemented with Keras to classify various types of honey based on input images. Users can select an image containing honey samples, upon which the system processes the image through the CNN model to predict the type of honey and potential adulteration. The system provides real-time feedback on the percentage of potential adulterants detected, along with the type of honey identified. Moreover, it integrates image processing techniques like color masking and contour detection to enhance the accuracy of classification. Overall, the system offers a user-friendly interface for efficient and reliable honey quality assessment.

4. Result and Discussion

The utilization of machine learning techniques for detecting honey adulteration presents promising outcomes. Through the application of various machine learning algorithms on spectral data obtained from honey samples, significant progress has been made in accurately identifying adulterated honey. Results indicate that machine learning models, such as support vector machines (SVM), random forests, and artificial neural networks, exhibit high accuracy rates in distinguishing between pure and adulterated honey samples based on their chemical compositions. Furthermore, the use of advanced feature selection techniques enhances the performance of these models by identifying key spectral features indicative of adulteration. However, challenges persist in developing robust and generalized models due to variations in honey composition and adulteration methods. Future research should focus on expanding the dataset to encompass a wider range of honey samples and adulterants, as well as refining machine learning models to improve their reliability and applicability in real-world scenarios. Additionally, efforts towards integrating portable spectroscopic devices with machine learning algorithms can facilitate on-site detection of honey adulteration, thereby enhancing food safety and consumer trust in honey products.

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