AUTOMATED CLASSIFICATION OF CRAB SPECIES AND EDIBILITY USING CONVOLUTIONAL NEURAL NETWORKS

Rationale

Crabs are valued as one of the favorite seafood choices and are enjoyed in different culinary forms like boiled, steamed, or prepared dishes in various parts of the world (Asakawa et al., 2010). A research expedition to the coral-rich waters of the Philippines uncovered approximately 1,200 species of shrimp, crabs, and lobsters, with several dozen thought to be previously undiscovered by scientists. Classifying the crab species and determining its edibility is significant in ensuring the safety of consumers. Although the majority of crab species are safe for human consumption, certain types can be toxic to humans. Several instances of food poison resulting from ingestion of crabs have occurred in the Philippines, leading to fatalities and hospitalizations. These occurrences emphasize the need for accurate crab species classifier and reliable methods to distinguish safe crab varieties from poisonous ones.

The existing study on classifying crab species using various machine learning models has demonstrated significant progress. However, it lacks feature of identifying the edibility of certain crab types. This deficiency represents a critical gap in current methodologies, particularly in the context of application like the safety of consumers. Thus, the researchers propose an image-based classification solution to identify the crab species and if it is edible by using the Convolutional Neural Networks. Convolutional neural networks (CNNs or ConvNets) represent a specialized type of deep neural networks designed to analyze input data possessing spatial structure (Goodfellow et al., 2016). By utilizing the CNN, this research aims to develop a system capable of not only classifying the crab species accurately, but also determining their edibility status.

The researchers will utilize various effective parameters to classify the crab species accurately such as the color, morphology, texture, patterns, and relative proportions of body parts. These parameters will help increase the accuracy of classifying the types of crabs. On the other hand, determining the edibility of crab requires accurate parameters as it is crucial in the proposed study. Some of the common toxins present in crabs are saxitoxin and tetrodotoxin, which are fatal to humans. Crabs do not develop toxins on their own, they only acquired it in their diet and bacteria in the environment (Jordan, 2021). Hence, crucial parameter to be used to identify the edibility of crabs is their dietary habits. Additional parameters include assessing color and texture, evaluating shape and size, detecting visual indicators of parasites, analyzing types of habitats, and the classification models of crab species.

The proposed image-based classification solution using Convolutional Neural Networks aims to produce significant impact to the food security and marine resources for sustainable development. This will be beneficial for marine biologists, ecologists, and researchers aiming to develop effective techniques for identifying crab species across varied marine habitats (Singh et al., 2023). Identifying crab species and determining their edibility status will innovate food safety protocols, particularly in seafood industries where the differentiation between edible and non-edible crab species is a concern.

The consumption of crabs as one of the favorite seafoods in the Philippines indicates the importance of identifying crab species and classifying their edibility. Thus, fostering this research proposal will develop a productive system that is useful for the consumers and other professionals. This study will contribute to the filed of computer science by introducing the novel approach to crab species identification with added feature for food safety. Moreover, the knowledge that will be obtained from this research opens doors for new advancements in image processing technology and its use in computer science.

Significance of the Study

The proposed study, “Automated Classification of Crab Species and Edibility using Convolutional Neural Networks” is significant in various fields. It addresses a gap in the current methodologies by providing a solution for accurately identifying the species of crabs and determining their edibility status. This advancement is important for the security of the consumers as it provides a reliable tool for identifying between safe and potentially toxic crab species, thereby mitigating the risk of foodborne illnesses and safeguarding public health.

This research will significantly contribute to the field of Computer Science by showcasing the effectiveness of CNNs image-based classification tasks in accurately determining crab species and edibility status. Furthermore, the findings of this study have practical implications in crab species classification with potential applications in various fields such as environmental monitoring and species conservation.

This research study directly contributes to SDG Goal 2: Zero Hunger as it enhances food safety protocols through the accurate identification of edible crab species. This has the potential to reduce the risk of foodborne illnesses associated with consuming toxic crab species, thereby improving food security. Thus, this study aligns with the objectives of SDG Goal 2 by promoting food safety and contributing to efforts aimed at eradicating hunger and malnutrition on a global scale.

Furthermore, this study also contributes to SDG Goal 14: Life below Water as it aids in the conservation and sustainable management of marine resources by providing a tool for accurately identifying crab species. This is essential for the preservation of marine resources, as it enables stakeholders to better understand and monitor crab populations in marine ecosystems. This will contribute to efforts aimed at maintaining the health and resilience of marine habitats through the implementation of the proposed automated classification system,

thereby supporting the long-term sustainability of marine ecosystems. Thus, this study aligns with the objectives of SDG Goal 14 by promoting the conservation and sustainable use of marine resources, which is essential r the health and well-being of both marine ecosystems and human populations dependent on them.

This study aligns with two thematic areas: Smart Engineering, ICT, and Industrial Competitiveness, and Agri-Fisheries and Food Security. In first thematic area mentioned, this research introduces innovative applications of Convolutional Neural Networks to automate the classification of crab species and determining the edibility status, showcasing the advancements in machine learning technology. Furthermore, this study directly addresses challenges in Agri-Fisheries and Food Security by enhancing food safety protocols through the accurate identification of crab species. It contributes to the global efforts of eradicating hunger and malnutrition through mitigating the risk of foodborne illnesses that promote food security and access to safe seafood products.

Scope and Limitations

This study focuses on the development and implementation of a Convolutional Neural Network (CNN)-based system for the automated classification of crab species and their edibility. The system processes crab images to identify species and determine whether they are edible or non-edible. The study covers data collection, preprocessing, model training, validation, and performance evaluation using various CNN architectures. The dataset consists of labeled crab images, which are used to train and test the model's classification accuracy.

The scope of this study is limited to crab species included in the dataset, meaning the system may not generalize well to species outside the collected data. Additionally, the classification is based solely on image analysis, without incorporating other biological or environmental factors that may affect species identification. The system's performance depends on image quality,

lighting conditions, and dataset diversity, which may influence accuracy. Finally, the study does not provide a complete taxonomic classification but rather focuses on species-level identification and edibility classification.

Objectives of the Study

The objective of the study, “Automated Classification of Crab Species and Edibility Using Convolutional Neural Networks” is to develop an automated classification system for accurately classifying crab species and determining their edibility status to enhance food safety protocols. In more specific terms, this research intends to achieve the following:

1. To train Convolutional Neural Network (CNN) model capable of accurately classifying crab species based on input images.
2. To integrate an edibility assessment module into the CNN model to determine the edibility status of identified crab species.
3. To collect a dataset of crab images composed of various species for model training and evaluation.
4. To validate the effectiveness of the proposed automated classification system in realworld scenarios.
5. To assess the practical implications of the study’s findings in enhancing food security.

Expected Outputs

The proposed study is expected to produce the following outputs:

Trained Convolutional Neural Networks (CNNs):

- Specifications: The CNN model will be trained using various dataset of crab images, incorporating different species.

- Datasets: A selected dataset of crab images collected from diverse sources, including online repositories and research databases.
- Algorithms: Deep learning algorithms like CNNs will be utilized for image classification tasks.

Edibility Assessment Module:

- Specifications: The edibility assessment module will be integrated into the CNN model to determine the edibility status of identified crab species. It will utilize additional data and algorithms for analyzing various features of crab images.
- Datasets: The toxicity information of crab species will be incorporated into the module to identify the edibility status.
- Algorithms: Machine learning algorithms will be utilized to analyze features related to crab edibility, such as color, texture, and morphology.

Materials to use:

Computing Resources: Machine learning libraries and frameworks, such as TensorFlow or PyTorch will be used for model training and experimentation.

Crab Image Dataset: Dataset of crab images will be selected from various sources to ensure the coverage of various crab species.

Documentation and Reporting Tools: Tools for documenting experimental procedures, recording results, and generating reports will be employed to ensure transparency and reproducibility of the research findings.

References

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