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Unlocking the Secrets of Ichthyology with Artificial Intelligence: A Taxonomic Revolution

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Abstract

This study examines unlocking the secrets related to the ichthyology related to the artificial intelligence. The result also describes that taxonomic revolution related to them. What an artificial intelligence (AI) is changing the subject of ichthyology, with a particular emphasis on how AI may completely change the taxonomy of fish. For determine the research study used smart PLS software and generate descriptive statistic, correlation coefficient also that smart PLS Algorithm model between them. The great diversity and subtle changes seen in the aquatic domain have presented obstacles to identifying and classifying fish species using traditional methods. The use of artificial intelligence, namely machine learning algorithms, is a viable approach to accelerate and improve the taxonomic procedure. Artificial intelligence (AI) can detect cryptic species, uncover hidden patterns, and adjust to changing taxonomic classifications by evaluating a variety of datasets that include morphology, genetics, and behavior. Beyond identification, AI helps conservation efforts by facilitating ecological studies and mapping distribution. To balance the interpretability of AI models, ensure data quality, and navigate ethical issues, ichthyologists and data scientists must work together transdisciplinaryly. This study imagines a future in which the combination of artificial intelligence and ichthyology would reveal the mysteries of fish variety and revolutionize our knowledge, conservation tactics, and sustainability initiatives in the aquatic realm.

Keywords: Unlocking (UL), Ichthyology (IC), Artificial Intelligence (AI), Taxonomic Revolution (TR), Smart PLS Algorithm

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Introduction

The word "Ichthyology" can be explained in these words "the branch of zoology which is related to the study of structure, characters, habitat, reproduction and other aspects of fishes". This branch includes the study of all types of fishes such as bony fishes, cartilaginous fishes, jawless fishes, and others. The main objective of this branch of zoology is to overview all the aspects of fish biology, including taxonomy, systematics, the aspect of evolution, biogeography, ecology, morphology, physiology, and others. The term "artificial intelligence " can be explained in these words "a computer-based system which works on such simulation and use of human-like intelligence process in the form of machines(Morris, 2015). Fish science, or ichthyology, has always been closely linked to the difficulties of taxonomy.

The intricate physical differences and nuanced genetic composition of fish species and their astonishing variety have frequently made the categorization procedure extremely difficult for ichthyologists. But things are changing, and artificial intelligence (AI) is bringing a technological tsunami to the field of ichthyology. The combination of AI with ichthyology promises to not only solve the mysteries of fish taxonomy but also to spark a taxonomic revolution in this age of unheard-of technological development. Fundamentally, the goal of ichthyology is to understand the vast array of fish species that inhabit the waters of our globe. Fish species display an astounding assortment of forms, sizes, colors, and behaviors, from the calm streams to the ocean's vast depths. Ichthyologists have historically depended on time-consuming techniques to identify species, such

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as careful inspection of anatomical traits and genetic analysis. However, this procedure takes a lot of time and is frequently open to varying interpretations. Artificial intelligence can perform different tasks such as translating languages, visual perception, and speech recognition. Artificial intelligence has many benefits in different aspects of human life, such as education, Healthcare, industry, research, job improvement, and others. This study overviewed the use of artificial intelligence in ichthyology, which would be a better step to understanding the morphology and physiology of fishes. Many factors are to be considered for optimizing fish production from an ecological perspective and conservation purposes. These factors are the life cycle of fishes, the impact of human activities on fishes, the effect of exploration at a commercial level, and others. To monitor these factors, we must do four jobs(Wordsworth, 1995).

The first job is to detect and exactly count the number of fish in that environment. The second step is to estimate the dimensions and weight of fish in that environment. The third is tracking different species of fish to determine the behavior of fish, and the fourth is a classification of fish to determine similarities and differences of different species of fish. Different artificial intelligence technologies can be used in fisheries. The first technology is deep learning, in which information is collected by different means and then studied to understand different aspects of that specimen. In this deep learning, various high-resolution imaging techniques are used to explain fishes' external and internal structure (Kingsland, 2023).

The high-energy X-rays and UV rays may be used to scan the internal system of fish. Then, this imaging technique is further used to discover new species of fish. The second technology of artificial intelligence is the storage of data in the form of electronic data. All the information related to the study and classification of fish can be stored in the form of electronic data, which reduces the chances of data loss(Stewart, 2011). Most importantly, all the research is performed using electronic systems, so there are few chances for any kind of instrumental error. If all the data by artificial intelligence technology is thoroughly understood, it can be used to improve the condition of stock assessments. It can help to identify and also monitor overfishing; thus, it can help to ensure sustainable growth of fish according to the surrounding environment.

The other artificial intelligence techniques are real-time monitoring, the analysis of data, the predictive model, and the support system of decisions(TROY, READY, HODGES, & Broadway, 1892). Some robotic techniques of artificial intelligence can be used to check the quality of water for proper growth and reproduction of fish. Some robotics can be used to inspect nets and mooring lines. The most important aspect of artificial intelligence is early disease detection in fish before the appearance of symptoms in them. Artificial intelligence can be used to study the genetic makeup of fish, which can help classify fish and understand their evolutionary relationships. Special types of sensors have been developed using artificial intelligence that can be used to locate the exact location of fish in a short time(Kingsland, 2023). Let us introduce artificial intelligence, a computing marvel that can analyze enormous volumes of data at a speed and precision never seen before. By using machine learning algorithms, we can determine the most effective feed for particular species of fish. Such feed is provided to fish, which produce less waste from the body. The study of fish behavior is very important to understand their type and classification(Boyd, 2017). High-resolution inspection cameras have been developed using artificial intelligence, which can easily detect the movement and behavior of fish and play an important role in the classification of fish.

When all these factors are easily controlled by using artificial intelligence, there would be optimizing change in the production and growth of fish in a particular environment(Fagan, 1996). This study has overviewed how artificial intelligence can be used to advance Ichthyology for classification and the Taxonomy of fishes. Along with this, there are some negative aspects of using artificial intelligence for Ichthyology. The first negative aspect is that it is highly costly to be used in Ichthyology. No doubt there is use of high-resolution instruments in the study of fishes, but these instruments seem costly, making them difficult to afford (Appudurai, 2015). The other aspect is that it needs highly skilled workers to operate these instruments, which makes it less reliable for a layman. Furthermore, AI is being used in ichthyology for purposes other than identification. Machine learning algorithms may analyze large datasets to find ecological trends, map the ranges of distribution, and even forecast possible effects of changing environmental conditions on fish populations. The capacity to handle and analyze such enormous volumes of data creates new opportunities for comprehending fishes' intricate interactions with their environments. The enduring problem of taxonomic revisions is also addressed by the collaboration of AI and ichthyology. Taxonomic classifications must be revised when new data become available and our comprehension of evolutionary connections advances. AI gives ichthyologists a dynamic toolkit that can adjust to shifting data environments, enabling them to precisely and quickly traverse the waters of taxonomy.

The other aspect is that artificial intelligence is decreasing the value of human intelligence, so the unemployment rate has been tremendously unceasing and increasing worldwide. The other aspect is that there is no doubt that in using artificial intelligence there are fewer chances for human error. Still, there are more chances for instrumental error sometimes by using different instruments(Greene, 2016). The job of deciphering the complexities of ichthyological taxonomy is especially well-suited for machine learning techniques, a subset of artificial intelligence. By feeding these algorithms with a comprehensive dataset that includes genetic sequences, behavioral patterns, and photographs of a variety of fish species, researchers may train AI models to identify small differences and patterns that could go unnoticed by the human eye.

Identifying cryptic species—those that seem almost similar but have minute genetic or morphological differences—is one of the major problems in ichthyology. If all these challenges are dealt with effectively, artificial intelligence can be used for ichthyology, which can ultimately be used for classification and taxonomy of fishes. This aspect of artificial intelligence proves the importance of using artificial intelligence in our daily lives (Robles, 2023). For this taxonomic revolution to be successful, ichthyologists and data scientists must work together. To guarantee the validity and dependability of the insights produced, a compromise must be struck between the effectiveness of artificial intelligence and the strictness of conventional scientific methodologies. However, the successful implementation of AI in ichthyology requires collaboration between ichthyologists and data scientists. This interdisciplinary approach is crucial for developing AI models that are not only effective in handling complex biological data but also aligned with the rigorous methodologies of traditional scientific practices. The collaboration between experts in fish biology and data science ensures that the insights generated by AI are not only innovative but also adhere to the established standards of validity and reliability.

Research objective:

The main objective of this study is to understand the use of artificial intelligence for Ichthyology. This study has also effectively explained the term Ichthyology, which is used to study the characteristics of fishes along with reproduction patterns. This study has also described the few negative aspects of using artificial intelligence for Ichthyology in the modern world.

Literature review:

Researchers claim that with the help of modern science-based knowledge, understanding life's evolution has become easier. life processes occurring on this planet are complex, and understanding this complexity of life is possible only through science (Chakrabarty, 2022).studies claim that Entrepreneurial universities use new initiatives to explain the reason behind climatic changes. The impact of climate change on natural ecosystems has been explained through the innovative measures employed by entrepreneurial universities (Etzkowitz, 2022).Studies claim that the sea has played a main role in the war between various states in the past century. Several maritime strategies were used during the competition between two superpower states(González Levaggi, 2023).

While ichthyologists offer their knowledge of fish biology, behavior, and ecology, data scientists may use artificial intelligence (AI) to handle and evaluate this volume of data. This collaboration's multidisciplinary approach may expedite findings and result in a more thorough and nuanced knowledge of fish diversity. AI integration in ichthyology has advantages for conservation initiatives as well. Since pollution, overfishing, and habitat degradation are major threats to many fish species, timely and accurate information is crucial for developing successful conservation strategies. studies explain that knowledge about life provides insight into various organisms' behavior. The information about species' genotype and phenotype is obtained using the life sciences approach. Each living system has a unique mechanism that maintains its life process. these mechanisms are termed life roles. Each organism has distant life rules that are understandable through the biological-based sciences. modern technology-based science provides detailed information about the life rules of each organism to understand the complexity of mechanisms a living system possesses (Holford & Normark, 2021).

Scholars predict that monitoring of aquatic species is carried out using the AT. The use of AT is common for managing aquatic life and conserving it. the old methods for tracking the fish species have been replaced with the new and advanced technology-based AT technique. the study of various aquatic species becomes easy through the use of AT. AT has applications for dealing with the challenges related to aquatic ecosystems. The revolution of aquatic-based AT technology in the past few years has made it the best tool for analyzing aquatic species(Jacoby & Piper, 2023).scholars explain that determining organisms' structure and elemental composition has been a task for scientists for millions of years. This task has been completed through the efficient use of modern technology-based techniques(Koldenkova & Lyubarsky) Studies shows that swarm are made of simple elementary units but still exhibit complex structural behavior .for behavioral analysis of swarm the use of computer based models is made. The computer model-based information predicts exposes the secret that swarms possess information that in nature expresses in analog from(Krzanowski & Polak, 2022).

Studies suggest that marine ecosystem observations are made using the robotics system to obtain the most UpToDate information about marine life. New and modern robotics systems can move along the boundary of air and water. these robots, capable of crossing air and water, are used for detailed analysis of aquatic species(Li et al., 2022).scholars explained that knowledge about fish diversity and aquatic ecological functioning is explained through fish biodiversity. aquatic ecosystem provides great ecosystem-based services to humans. Using the fish biodiversity concept provides relevant information about the importance of certain fish species for humankind so that people can use these species as a food source(Lynch et al., 2023).

Scholars explained that eel has a special place in fish taxonomy because of its complex taxonomy. The life cycle of the eel is highly complex, and to get information about it, the use of multidisciplinary approaches is made by ichthyologists studying eels. In the past, understanding the eel life cycle was difficult because of a lack of modern technological concepts, but due to new and revolutionized scientific approaches, the complex behavior of ells is understandable(Mapes & Mouillot, 2023). Studies reveal that data about the natural ecosystem is critical in determining the biodiversity associated with fish species. Digitalizing the natural aquatic history has improved the information accessibility process related to aquatic life. The approach of machine learning has been employed in the digitalization of aquatic-based history for solving the modern problems related to marine ecosystem(Robillard, 2022).

Moreover, understanding about the unknown and curious species has been possible by comprehending the natural history behind the aquatic species.by studying the natural history of related to marine species it becomes easier to know about the unknown species of marine ecosystem. Understanding a species' history context makes it easy to know about the new variety of that specie(Robles, 2023). Studies elaborate that humans have a deep connection with biodiversity. The interaction of humans with certain microorganisms explains that humans are related to biodiversity. the loss of biodiversity results in increased threats to humans. oceanic biodiversity is associated with human survival so maintaining aquatic biodiversity holds critical importance(Sánchez, 2023).

Studies scholars predict that increases in fish biodiversity are marinated through the use of technology-based monitoring systems. The auto fish is an automatic fish tracking and monitoring system that tracks fish to provide information about their color and gill functioning. The use of android-mobile apps for navigating underwater fish species is increasing. Marine-related researchers employ modern technology-based techniques and models to specify the fish found in different locations and classify region-specific fish species (Solanki, Thakur, Mhaskar, Chavan, & Koli, 2023).studies claim that a brief introduction to life and its related phenomena helps explain different species' living styles.(Todes, 2022).studies describe that climatic changes impact the life of aquatic ecosystems.

To know about the impact of climatic change on aquatic life, the use of a modern scientific approach is important for maintaining biodiversity. The modern technology eDNA is used for assessing the behavior of estuarine aquatic species under extreme climatic conditions(Tout-Lyon, 2023) Also, the process of involvement of the public in knowing about the aquatic life is improved using the modern technology apps. incorporating mobile apps in a citizen science-related approach improves the process of comprehension of aquatic-related phenomena. the combination of two modern approaches provides authentic data relevant to the taxonomic behavior of aquatic species. the interest of the public in gaining insight into the aquatic life-related process increases through the use of mobile apps(Tréhin, 2023).

Scholar studies reveal that spices belonging to the kingdom Mamaliga are abundant in aquatic ecosystems. The biodiversity of aquatic systems is largely based on these big Mammalia species. The knowledge about the diversity and ecology associated with Mammalia kingdom species is obtained using modern scientific approaches(Feldhamer, Merritt, Krajewski, Rachlow, & Stewart, 2020).scholars' studies show that salmon species' behavior and life cycle are explained through cognitive ethnography(Solberg, 2021).

Moreover, the use of the eDNA technique for studying various fish assemblages is gaining popularity. The polarity of eDNA technology for studying aquatic life is because this technique provides more detailed and advanced information about the problems faced by marine ecosystem than any other technology techniques(Roe, Tout-Lyon, Price, & Rees, 2023). AI can evaluate satellite pictures, other environmental elements, and monitoring data to determine the health of fish populations and direct conservation efforts. Although the combination of AI and ichthyology offers many promising prospects, there are drawbacks. Important aspects that require careful study are data quality, interpretability requirements for AI models, and ethical issues. By spotting hidden patterns and making connections that more conventional approaches might miss, artificial intelligence (AI) has the potential to completely transform this area of taxonomy. This improves the accuracy of species categorization while simultaneously speeding up the identification procedure. The other artificial intelligence technology is machine learning, which has a leading role in improving fish production.

Researchers claim that the decline in various fish species is due to certain anthropogenic factors. The decline rate of whale sharks has increased due to these factors. To understand the sustainability of known species of the fish population, it is essential to understand the interaction of humans with the fish species. The interaction of fish species with humans helps predict the reason for oceanic species' movement. in the past, little was known about the location and migration of whale species in the ocean, but with the use of AI-based systems, the migration patterns of whale species are recognizable. To identify the location and areas with a high concentration of whale species, ichthyologists use SSM and MPM. By combining the data of the SSM and MPM models with environmental data, the patterns of migration of whale species are predicted. also, the aggregation of whale species is determined by using the ML approach in the use of MPM models(Daye, 2023).studies reveal that the life cycle of some species is based on their migration patterns.

The Eel species require fresh and salt water to complete their life cycle. The drastic fragmentation of habitat is caused due to the effect of anthropogenic factors on freshwater ecosystems. because of the destruction of habitat, the aquatic fishes are bound to migrate.to understand the migratory behavior of fish in response to the destruction of one aquatic ecosystem, the use of a technology-based monitoring system is common. the technology monitoring models provide data about behavioral fish migration. The technology-based models provide insight into navigational cues that fish species use. The knowledge related to the fish cues is explained through the use of ML-based models. moreover, the knowledge related to fishway cues improves the experimental designs to study fish ecosystem-related conditions(Elings et al., 2023).

Studies highlight that the oceans are polluted due to climatic shifts as well as the discharge of pollutants into the water. The pollutants released in the oceans pose a great threat to the aquatic life. Aquatic biodiversity is losing at an alarming rate due to these harmful pollutants. The approach of oceanic sciences provides great aid in solving the problem related to oceanic pollution. oceanic science is a modern field that provides knowledge related to ocean life and also provides effective strategies to conserve oceanic ecosystems. By using monitoring cameras underwater, pollutants can be easily identified. After the identification of pollutants, they are removed from the ecosystem promptly before they harm the life cycle of aquatic species (Forrest, 2019).studies suggest that the revolution in the field of technology has revolutionized almost every field. The deep learning algorithms are the revolutionized algorithms that are used for managing data in bulk. The data related to the marine ecosystem is managed using the DL algorithms. Marine ecosystem-associated data is first obtained using the sensors-based monitoring system and acoustic record system.

The motoring sensors unveil the secrets related to the movement of fish under certain circumstances, whereas the acoustic recording system unveils the secrets related to the sound produced by different aquatic species. The tremendous applications of DL in the marine field make it the best AI technique for managing marine ecosystem(Goodwin et al., 2022).studies elaborate that the history of aquatic ecosystems suggests a deep relationship between humans' interaction with marine ecosystems. This history explains that due to various human activities, there has been a diverse exchange in the patterns and life Cycle of fish species. The secrets related to the change in patterns of fish species over time due to human interaction with the aquatic ecosystem are explained using modern AI techniques.

The AI-based tools provide detailed data on the history of fish species and the evolution each fish species has undergone over time.by obtaining the data related to fish evolutionary history, the shift in the behavioral patterns of fish species can easily be explained(Hoffmann, 2023).studies reveal that fish species are considered as the oldest living organisms found on the earth. The types and varieties of fish species are diverse. around 30 fish species are found in the sea. Each species has a unique life cycle that makes each fish species different. To understand the complexity of the life cycle of fish species and to unlock the secrets related to the taxonomic behavior of species, AI-based techniques are employed in the study of the aquatic ecosystem(Prosper et al., 2023).

Also, a large number of people depend on fish for nutrient sources. so understanding each aquatic species using AI tools helps conserve the aquatic species.to identify different underwater fish species, YOLOv5 models are made .These models provide high-accuracy data related to the species found underwater(Radha, Swathika, & Shreya, 2022).Studies predict that AI-based techniques are used to determine the information about alien species sound in aquatic environments. The records related to the species found on the black sea can be obtained using special models. the records obtained from the black sea using the AI tools predict the existence of naïve and marine species in the black sea. These alien species pose unique characteristics different from the aquatic species normally found in the marine ecosystem(Ragkousis et al., 2023).

Studies reveal that the information related to the natural history obtained through traditional methods was not accurate. obtaining the information related to the natural history of marine ecosystems using the next generation technology is more accurate. Advancements in technology have improved the precision of data associated with aquatic ecosystems. Using electric sensors as well as remote monitoring devices to obtain data related to the historical context of aquatic species is important. the next-generation marine ecosystem-based information helps in identifying the wonders of aquatic ecosystems. various novel and unique species can be identified through the use of technology-based data-obtaining tools(Akman, Arriola, Schroeder, & Ghosh, 2023).

Furthermore, the next generation's natural history related to aquatic life helps in conserving and managing aquatic species to save them from becoming extinct. also, to save the novel aquatic species from various threats the next generation technological methods are employed in the aquatic life conservation models(Tosa et al., 2021).

Descriptive statistic:

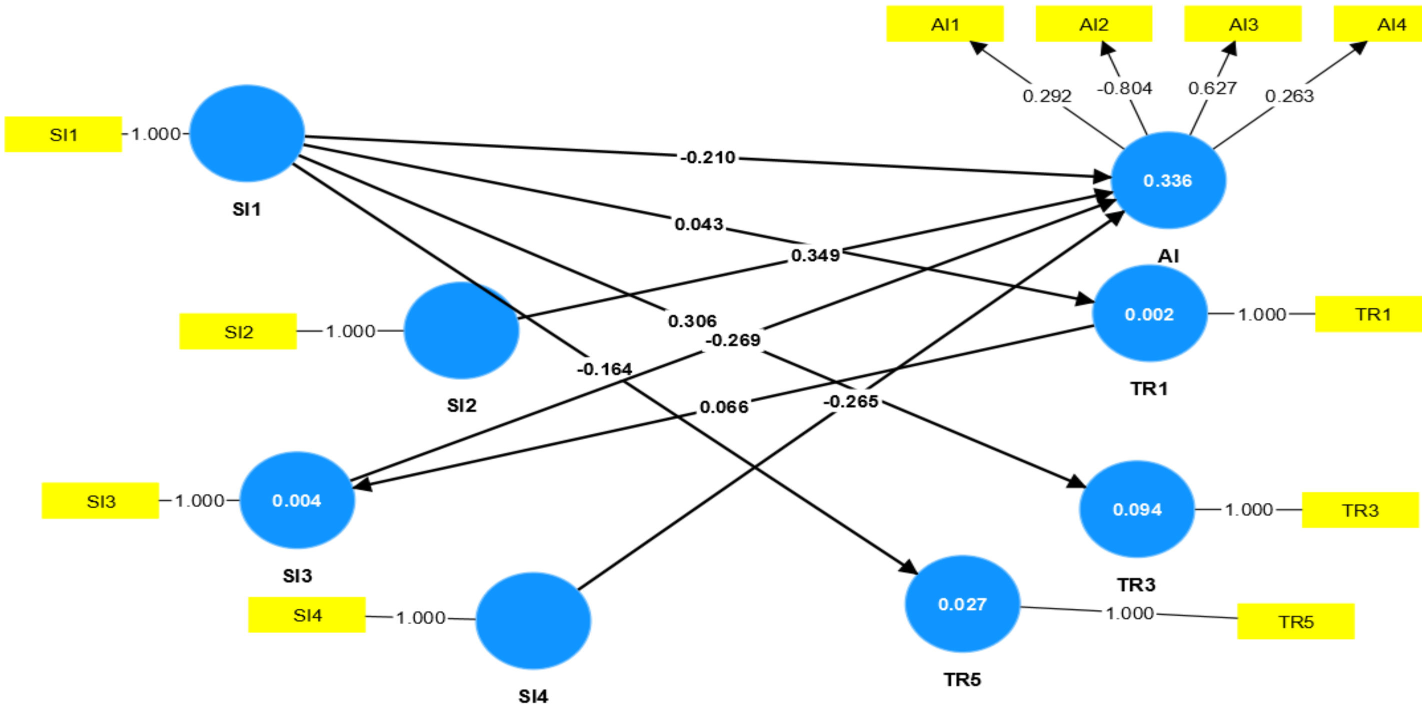
Name	**No.**	**Mean**	**Median**	**Scale min**	**Scale max**	**Standard deviation**	**Excess kurtosis**	**Skewness**	**Cramér-von Mises p value**
SI1	0	1.510	1.000	1.000	3.000	0.576	-0.554	0.621	0.000
SI2	1	1.551	1.000	1.000	3.000	0.641	-0.403	0.763	0.000
SI3	2	1.694	2.000	1.000	3.000	0.645	-0.664	0.403	0.000
SI4	3	1.776	2.000	1.000	3.000	0.678	-0.807	0.319	0.000
AI1	4	1.510	1.000	1.000	3.000	0.576	-0.554	0.621	0.000
AI2	5	1.531	1.000	1.000	3.000	0.575	-0.634	0.541	0.000
AI3	6	1.735	2.000	1.000	4.000	0.827	0.419	0.989	0.000
AI4	7	1.714	2.000	1.000	4.000	0.756	0.241	0.836	0.000
TR1	8	1.918	2.000	1.000	4.000	0.853	-0.460	0.568	0.000
TR2	9	1.449	1.000	1.000	2.000	0.497	-2.040	0.212	0.000
TR3	10	1.653	2.000	1.000	3.000	0.656	-0.659	0.522	0.000
TR4	11	1.469	1.000	1.000	2.000	0.499	-2.070	0.127	0.000
TR5	12	1.592	2.000	1.000	3.000	0.603	-0.589	0.496	0.000

Table-1

The above result describes that descriptive statistical analysis result represent the mean values, the median rates also that represent the standard deviation included skewness values and probability values of each indicators included independent and dependent. The SI1, SI2, SI3 and SI4 shows that mean values are 1.510, 1.551, 1.691 also that 1.776 all of them are shows that positive average values of mean. The result describe that standard deviation rates are 62%, 76%, 40%, and 31% deviate from mean. The overall probability value is 0.000 shows that 100% significant level between them.

In summary, the combination of ichthyology with artificial intelligence signals the beginning of a new chapter in the study of fish variety. This taxonomic revolution has the potential to change our understanding, categorization, and conservation of fish species in addition to revealing the mysteries of ichthyology. The partnership between ichthyologists and AI specialists will be the compass pointing us in the direction of a more profound and enlightened understanding of the aquatic environment as we traverse these unexplored seas of innovation. the result describes that SI1, SI2, SI3 and SI4 these are all shows that mean values are 1.776, 1.510, 1.531 also that 1.776 respectively these rates are present positive average value of mean.

Smart PLS Algorithm Model:



The above model represents that smart PLS Algorithm related to SI1, SI2 and SI3 its describe that -0.210 negative link with AI its present that 21% significant link with them. Even though they are time-tested, ichthyology's standard approaches have repeatedly failed to keep up with fish species' immense complexity and diversity. In the struggle to answer the puzzles of ichthyological taxonomy, artificial intelligence (AI) shows to be a formidable ally due to its potential to scan enormous datasets and find minute patterns. Beyond basic identification, artificial intelligence (AI) has ramifications in ichthyology that transcend ecological understanding and conservation. the SI2 also describe that 34% positive and significant relation with them the result also describes 0.292, -0.804, 0.627 also that 0.263 these are all describe that some negative and some positive relation between them. similarly, the SI3 shows that 6% positive link between them.

Correlation coefficient:

	SI1	**SI2**	**SI3**	**SI4**	**AI1**	**AI2**	**AI3**	**AI4**	**TR1**	**TR2**	**TR3**	**TR4**	**TR5**
AI1	-0.108	0.344	0.036	0.137	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AI2	0.353	-0.184	0.383	0.148	-0.078	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AI3	-0.144	0.199	-0.076	-0.324	-0.016	-0.133	1.000	0.000	0.000	0.000	0.000	0.000	0.000
AI4	-0.040	0.156	0.155	-0.125	0.007	-0.074	0.140	1.000	0.000	0.000	0.000	0.000	0.000
SI1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SI2	-0.209	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SI3	0.036	0.013	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SI4	0.241	0.191	0.030	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TR1	0.043	-0.030	0.066	-0.137	-0.206	0.047	0.461	0.027	1.000	0.000	0.000	0.000	0.000
TR2	-0.372	0.248	-0.144	-0.185	0.412	-0.548	0.289	0.287	-0.058	1.000	0.000	0.000	0.000
TR3	0.306	0.066	-0.058	0.329	0.090	0.217	-0.245	0.088	-0.051	-0.273	1.000	0.000	0.000
TR4	0.587	-0.171	0.129	0.251	-0.194	0.625	-0.341	-0.077	-0.102	-0.685	0.497	1.000	0.000
TR5	-0.164	0.159	0.046	-0.374	0.188	-0.082	0.355	0.371	0.213	0.407	0.106	-0.245	1.000

Table-2

The result represents that correlation coefficient analysis result describe that some negative and some positive correlation and interrelation between them. the TR shows that 58% positive interrelation with SI. A dynamic toolset for analyzing complicated relationships in aquatic ecosystems, anticipating the consequences of environmental changes, and guiding effective conservation initiatives is offered by machine learning algorithms. We have an incredible potential to produce ground-breaking discoveries at the confluence of biology and technology. This expedition into unfamiliar seas is not without obstacles, though. A rigorous approach is necessary owing to ethical limitations, data quality, and the interpretability of AI models. To ensure the authenticity and reliability of the insights produced, achieving a good balance between the efficacy of AI and the strictures of conventional scientific techniques is necessary.

Conclusion:

To sum up, integrating ichthyology with artificial intelligence offers a paradigm revolution in how we observe and identify fish species. AI's driving force behind the taxonomic revolution promises efficiency, accuracy, and a deeper dive into the secrets under the surface. The research determines that taxonomic for determine the research used smart PLS software and generate informative results included descriptive statistic, correlation coefficients also that smart PLS Algorithm model between them. Collaboration is vital to this taxonomic revolution's success. it will allow ichthyologists' expertise and data scientists' computational talents to be integrated. By working together, they build a synergistic partnership that forges ahead into creative seas and enhances our understanding of fish diversity. This multidisciplinary approach is an effort to drive ichthyology towards a more full, nuanced, and sustainable future. it is more than only a merging of fields. Over research concluded that there are direct and significant link between them. The application of artificial intelligence to unravel ichthyological riddles drives us to embrace a new era of knowledge as we begin out on this intriguing adventure. It is a call to research, change, and develop, bringing ichthyology to the lead of science. The once-difficult depths of fish taxonomy now present a lighter and more vivid vision of the aquatic environment via the lens of AI, providing a legacy of knowledge that will survive for future generations.

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