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Saad Motahhir
Badre Bossoufi *Editors*

Digital Technologies and Applications

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We are honored to dedicate the proceedings of ICDTA'24 to all the participants and committees of ICDTA'24.

Preface

This volume contains the third section of the written versions of most of the contributions presented during the conference of ICDTA'24. The conference provided a setting for discussing recent developments in a wide variety of topics including artificial intelligence, Internet of Things, embedded systems, chatbot, network technology, digital transformation and their applications in several areas as Industry 4.0, sustainability, energy transition, healthcare, etc. The conference has been a good opportunity for participants from various destinations to present and discuss topics in their respective research areas.

ICDTA'24 conference tends to collect the latest research results and applications on digital technologies and their applications. It includes a selection of 212 papers submitted to the conference from universities and industries all over the world. This volume includes a quarter of the accepted papers. All of the accepted papers were subjected to strict peer-reviewing by 2–4 expert referees. The papers have been selected for this volume because of their quality and their relevance to the conference.

We would like to express our sincere appreciation to all authors for their contributions to this book. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank Organizing Committee for their hardworking. Finally, we would like to thank the Springer publications for producing this volume.

S. Motahhir
B. Bossoufi

Acknowledgments

We request the pleasure of thanking you for taking part in the third edition of the International Conference on Digital Technologies and Applications (ICDTA'24). We are very grateful for your support, so thank you everyone for bringing your expertise and experience around the conference and engaging in such fruitful, constructive and open exchanges throughout the two days of the ICDTA'24 conference.

We would like to extend our deepest thanks and gratitude to all the speakers for accepting to join us from different countries. Thank you for being such wonderful persons and speakers. Again, thanks for sharing your insight, knowledge and experience.

Of course, this event could not be that successful without the effort of the organizing and technical program committees. Therefore, we would like to express our sincere appreciation to all of you who generously helped us.

We would like to especially thank all the participants for the confidence and trust you have placed in this conference. We hope we lived up to your highest expectations.

Our humble acknowledgement would be incomplete without thanking our sponsors and host. We would like to thank Mister Mohamed Bousseta, the General Director of Green Energy Park.

S. Motahhir
B. Bossoufi

Contents

Artificial Intelligence, Machine Learning and Data Analysis

Predicting Loquat Quality Using Visible, Near Infrared Spectroscopy and Artificial Neural Network

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Abstract. The main objective of this study is using Visible and Near-Infrared Spectroscopy (Vis/NIRS) as a simple, fast and non-destructive method, combined with Artificial Neural Network (ANN) in order to build three ANN models for predicting fructose, glucose and pH levels in loquat. A huge amount of spectral data characterizing each sample was extracted. In addition, by applying destructive procedures, soluble sugar content (glucose and fructose) and pH were determined. Feature selection was employed to select the most suitable wavelengths from the raw spectra. Afterwards, ANN was applied to quantify the three physico-chemical properties of loquat. Different feature selection algorithms were tested, namely Least Absolute Shrinkage and Selection Operator (LASSO), Interval Random Frog (iRF), Variable Iterative Space Shrinkage Approach (VISSA) and Interval VISSA (iVISSA). As a result, ANN models based on feature selection (VISSA) gave the best results compared to those obtained using full spectra. The performance of the ANN models in quantifying the three loquat properties were: a prediction determination coefficient ($R^2_p = 0.97$), ($R^2_p = 0.98$), ($R^2_p = 0.98$) and a standard error of prediction ($SEP_{pH} = 0.08$), ($SEP_{glucose} = 0.30°Bx$) and ($SEP_{fructose} = 0.34°Bx$) for pH, glucose and fructose prediction respectively. The results indicate the power and efficiency of combining Vis/NIRS and ANNs to predict loquat quality. Furthermore, this research can be extended to other food products.

Keywords: Loquat · Quality · Visible and near-infrared spectroscopy · Artificial neural network

1 Introduction

Loquat (Eriobotrya japonica) is a tree belonging to the Rosaceae family with evergreen leaves [1]. The main producer of this fruit is China, with annual production of around 1 million tons and an area of around 170 000 ha [2]. Today, loquat is grown in over 20 countries, including China, Japan, India, Brazil, Italy, Spain, Turkey and the United States [3]. Morocco is also one of the countries producing the loquat, introduced at the end of the 19th century. This fruit is juicier and sweeter of good size and pleasing appearance. In

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addition, it is an important source of vitamins and minerals such as calcium, potassium, phosphorus and magnesium, which are essential to the human body [3]. Loquat has a short storage life (10 days maximum at normal temperature) and cold storage is a useful technique for extending its post-harvest life [4]. In recent years, loquats have come to be preferred for their special flavor and high phytochemical content [5]. Studying this fruit amounts to investigating its quality, which is a reference criterion for a food product. There are two types of quality attributes: external and internal. The external quality refers to the extrinsic products qualities such as brightness, color and packaging. Whereas internal quality includes the chemical compositions of food products, affecting sugar content (glucose, fructose), acidity (pH)…etc. Therefore, it is necessary to control and evaluate the quality and safety characteristics of food products in all food industry processes.

Various destructive techniques has been used to assess the quality characteristics of food products, including High Performance Liquid Chromatography (HPLC) [6], Liquid Chromatography-tandem Mass Spectrometry (LC-MS/MS) [7] and Gas Chromatography – tandem Mass Spectrometry (GC – MS/MS) [8]. Most of these techniques are time-consuming, destructive and require sample preparation and handling. There is therefore a strong demand for inexpensive, effective and rapid techniques for food quality control. The most widely used and flexible techniques are non-destructive optical methods. They are considered powerful tools for internal quality analysis and assessment [9]. NIRS is one of the most powerful analytical methods, based on the interaction between light and matter. It is used in a variety of fields, notably the pharmaceutical industry [10], chemistry [11] and agri-food [12, 13]. The application of NIR spectroscopy in the agri-food sector allows significant analyses to be carried out on various fruits such as apricot [14], apple [15] and peach [16]. Spectral data sets can be analyzed and processed using various mathematical and statistical tools, such as chemometrics [17–19] and artificial neural networks [20].

ANN is a tool for modeling non-linear statistical data in order to find patterns or complex relationships between inputs and outputs. The philosophy behind these neural networks is based on a mathematical approach designed to mimic the workings of the human brain [21], which has formidable information-processing power. The most commonly used learning algorithm and neural network architecture are the backpropagation algorithm and the multilayer network design, due to their simplicity and good generalization capability [22]. A multi-layer neural network consists of three layers: the input layer from which the input data comes, the hidden layers for processing the input data and an output layer which provides the output data. The application of ANN concerns several fields, such as agriculture [23], medical [24], archaeology [25] and psychology [26].

In this work, Vis/NIRS combined with ANN-based feature selection was used as a non-destructive technique for simultaneous quantitative analysis of three physico-chemical properties (pH, glucose and fructose) of loquats. ANN-based feature selection has been explored to analyze spectral data. The wavelength selection algorithm VISSA has proven effective in selecting informative wavelengths from raw Vis/NIR spectra. The approach taken in this study can be extended to study the quality of other products in the food industry.

2 Materials and Methods

2.1 Samples Collection

The collection of loquat samples was made in the Zegzel valley, which extends over the rural commune of Zegzel, a few kilometers from the town of Berkane located in northeastern Morocco.

In this study, 149 samples were collected manually on the basis of size, defects and color to get an indication of morphological characteristics.

2.2 Spectra Acquisition

The experimental set-up used for spectra acquisition consists of a light source (halogen lamp, power = 50 W) located at 15 cm from the surface of the fruit, a rotating sample holder linked to a low-speed motor used to rotate the sample, so the light from the source interacts with a large surface of the sample. The reflected light from the samples (reflection mode) was guided by an optical fiber (2 m long and 400 μm in diameter) to a 2048-pixel Si-CCD (Coupled Charge Device, AVS-USB2000, Netherland) spectrometer, operating in the spectral range 500–1000 nm. The spectrometer was connected to a computer via USB to visualize the spectra by means of Avantes software. The sample rotates at a speed of one turn every 9 s to obtain a higher signal-to-noise ratio. The most suitable experimental conditions for spectra acquisition were: an integration time of 150 ms and an average of 60. These conditions were chosen to ensure that the fruit was analyzed from all angles, permitting an average spectrum to be obtained representing the sample from all angles. Hence, a good signal-to-noise ratio was achieved.

2.3 Measurement of Soluble Sugar Content and pH

After harvesting the loquat, absorbance spectra of the samples were acquired, then the fruit was compressed and the extracted juice is filtered. Some parameters directly related to fruit quality were measured, specifically glucose, fructose and pH. The glucose and fructose were determined by digital refractometers (Refractometer, Hanna Instrument, HI 96802) and (Refractometer, Hanna Instrument, HI 96803) respectively. Moreover, pH was measured using a pH meter (Hanna Instrument, HI 2210). A summary of the statistical properties associated to the data is presented in Table 1.

Table 1. Some statistical properties of loquat

Trait	Maximum	Minimum	Mean	SD
pH	5.06	3.04	3.87	0.42
Glucose (^{o}Bx)	17.40	6.30	11.59	2.27
Fructose (^{o}Bx)	17.50	6.40	11.41	2.26

2.4 Feature Selection

Before data analysis by ANNs, one of the most important steps is to transform the data in a suitable and compatible format. Feature selection is a widely used method for selecting informative variables and eliminating uninformative and redundant ones. This approach helps to avoid common machine learning problems, such as over-fitting and under-fitting. Furthermore, it improves model performance and generalizability, as well as reducing model complexity.

In this study, due to the large spectral data size, feature selection was applied to select the most suitable variables for predicting the three loquat characteristic parameters. Several algorithms were tested to improve models' efficiency, among them: LASSO, iRF, VISSA and iVISSA. The best results were obtained using the algorithm VISSA [27] on the raw spectral data. Among the 1000 variables extracted by the Vis/NIRS technique, the algorithm selected 164, 122 and 159 ones to be used for predicting pH, glucose and fructose respectively.

2.5 Artificial Neural Network Model

After feature selection, the next step was to develop models using ANNs capable of predicting the three loquats' characteristics. In this study, all developed models consist of three types of layers: an input layer that receives Vis/NIR data after feature selection, a hidden layer characterized by a tangent sigmoid activation function to process the data, and an output layer in which the three key loquat parameters are stored, characterized by a linear activation function. Three models were developed with the following architectures: 164–3-1, 122–9-1 and 159–8-1 for predicting pH, glucose and fructose respectively. The number of neurons in the hidden layer was chosen experimentally to minimize the errors. The approach followed was to start with a simple architecture with few neurons in the hidden layer, then complicate the architecture until a high-performance model was found.

The ANN used exploits the Levenberg-Marquardt algorithm in the learning phase due to its speed, low probability of overfitting and performance compared to other algorithms in performing prediction tasks. Model performance was assessed by calculating the Mean Square Error (MSE), Standard Error of Calibration, Validation and Prediction (SEC, SECV and SEP), regression coefficient (R) and determination coefficient (R^2). A high-performance model is characterized by low errors and a regression or determination coefficient close to 1.

2.6 Software

MATLAB R2018a software was used for all data processing. This software offers advanced features for the design, training and validation of ANNs. In addition, it allows the use of predefined algorithms and functions, such as learning algorithms and activation functions.

3 Results and Discussion

3.1 Spectral Feature

Vis/NIR spectra were acquired in the spectral range 500–1000 nm. However, due to the noise present in the extremities of Vis/NIR spectra generally, the spectral range was reduced to 580–920 nm. This was achieved by eliminating the visual noise at the edges, thus improving the signal-to-noise ratio.

Figure 1 shows the raw absorbance spectra of 149 samples in the spectral range 580–920 nm. An absorption band is visible around 680 nm, corresponding to the absorption of chlorophyll molecules. Consequently, samples with a high intensity of this band are less mature and vice versa. In addition, observing the band's intensity provides an indication of the fruit's maturity, i.e. the glucose and fructose content decreases with increasing band intensity. However, it is impossible to quantify soluble sugar content (glucose and fructose).

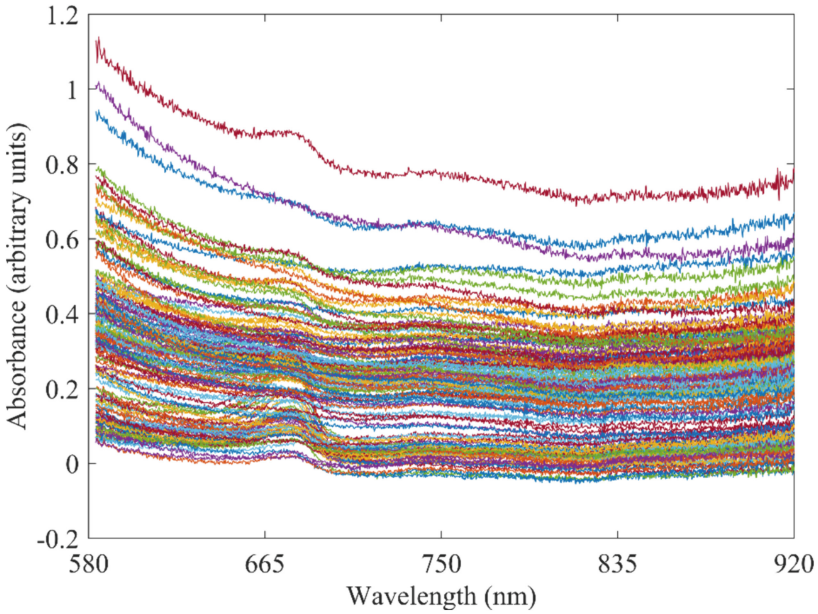

Fig. 1. Raw absorption spectra of loquats in the spectral range 580–920 nm

3.2 Feature Selection

Feature selection algorithms were employed to extract informative wavelengths from the raw spectra. The best result was achieved using VISSA with a prediction determination coefficient 0.97, 0.98 and 0.98 for predicting pH, glucose and fructose respectively.

In the present work, the VISSA algorithm has been used several times on the raw data in order to extract the maximum amount of information. The first time, it is used on

the data extracted by the Vis/NIRS technique, then again on the new variable extracted by VISSA and so on until a satisfactory result is found or the algorithm considers all features as important, i.e. all features have been selected and none excluded.

Figures 2a, b and c illustrate the Vis/NIR spectra and the selected spectral features using the VISSA algorithm for the predicting pH, glucose and fructose respectively. As can be noted, the selected variables were different for pH, glucose and fructose.

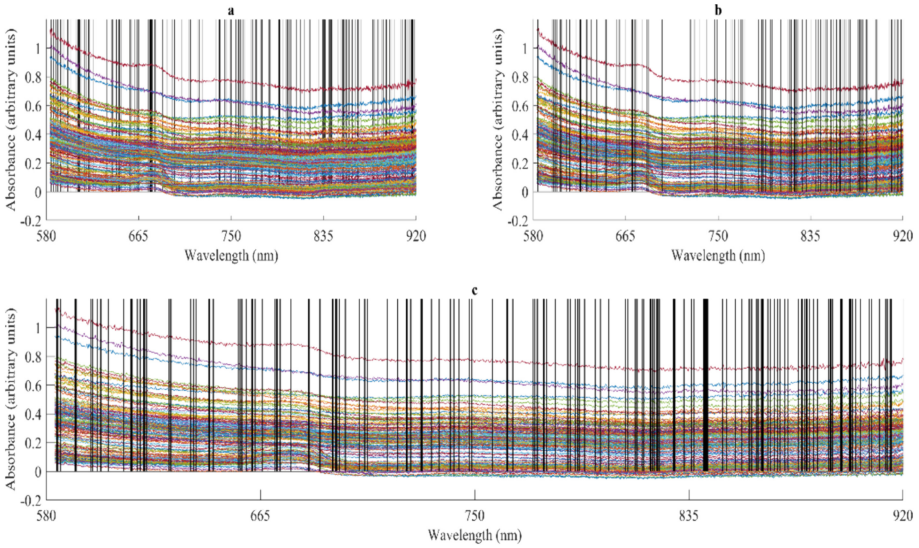

Fig. 2. Wavelengths selected by VISSA for quantifying (a) pH (b) glucose and (c) fructose

3.3 Artificial Neural Network Model

Spectral data collected for 149 samples after feature selection were first divided into two parts: 80% for model training and validation and 20% for prediction. Thereafter, three ANN models were developed to predict the three loquat characteristics. For all models, 5-fold cross-validation was used to validate them. In addition, the generalizability of the models was tested by independent 20% samples. The choice of developing three networks, each one capable of predicting one loquat characteristic, allowed very accurate models to be obtained. The use of a single model to predict all three characteristics at once was tested. However, the results were insufficient.

Figures 3, 4 and 5 represent the three regression plots obtained by the three developed models. They show a representation of the actual values of the three characteristics versus the predicted values. It can be noted that the regression coefficients of the three learning phases are close to each other and close to 1 for all three models, indicating that these models don't suffer from over-fitting or under-fitting problems and that the model generalizes well to the test data (prediction data). Furthermore, the samples are placed on or close to the regression line, meaning that the predicted and actual values are close to each other. Table 2 summarizes the results of this study.

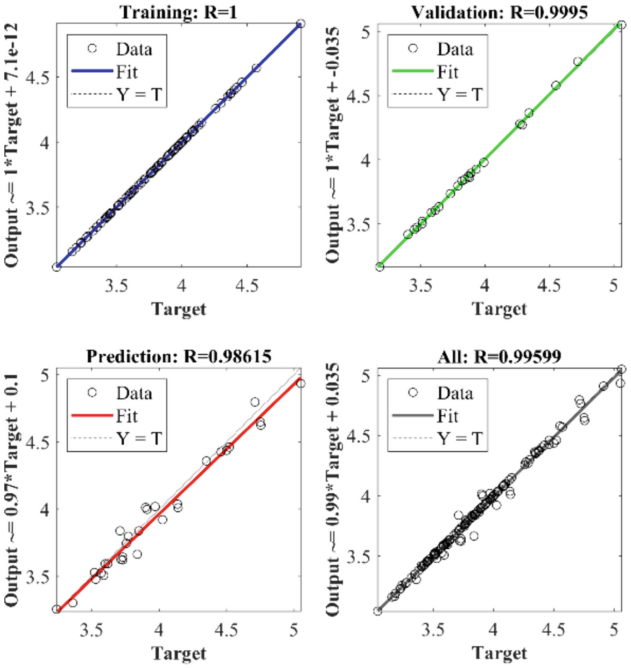

Fig. 3. Regression plots for training, validation, prediction and all for pH prediction

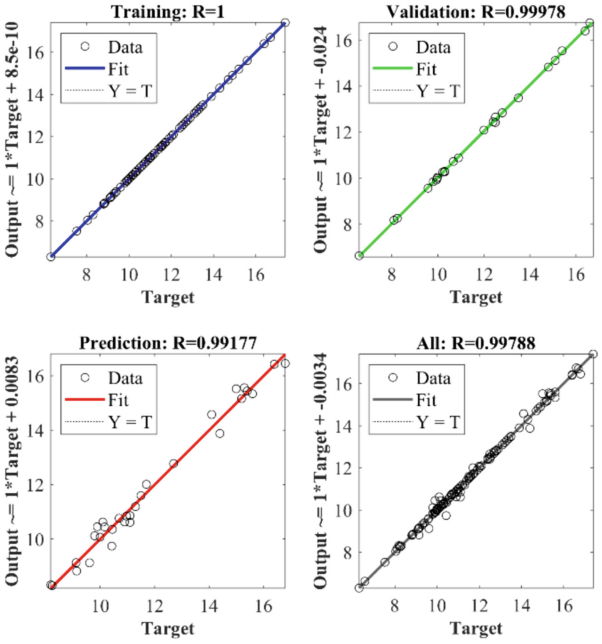

Fig. 4. Regression plots for training, validation, prediction and all for glucose prediction

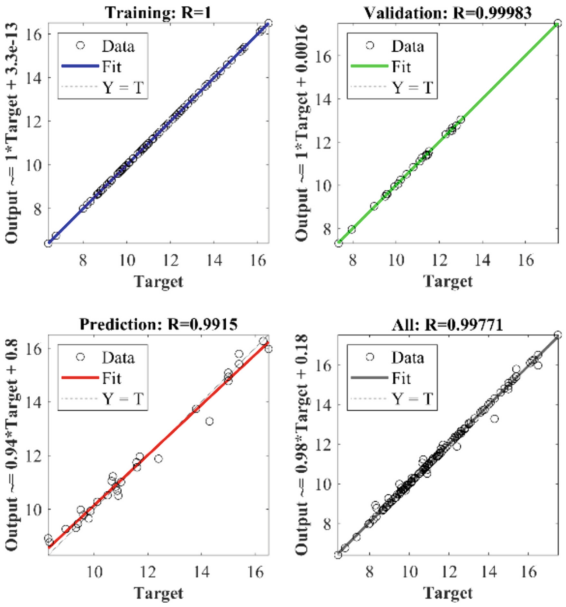

Fig. 5. Regression plots for training, validation, prediction and all for fructose prediction

Table 2. Summary of statistical parameters obtained by the three models

Characteristic	Learning phase	R2	MSE	SEC/V and SEP
pH	Training	1	1.3 × 10–21	3.6×10^{-11}
	Validation	0.99	2.4×10^{-4}	1.5×10^{-2}
	Prediction	0.97	6.9×10^{-3}	8.3×10^{-2}
Glucose (^{o}Bx)	Training	1	1.4×10^{-18}	1.2×10^{-9}
	Validation	0.99	4.2×10^{-3}	6.4×10^{-2}
	Prediction	0.98	1×10^{-1}	3.2×10^{-1}
Fructose (^{o}Bx)	Training	1	3.9×10^{-22}	1.9×10^{-11}
	Validation	0.99	1.5×10^{-3}	3.8×10^{-2}
	Prediction	0.98	1.1×10^{-1}	3.4×10^{-1}

4 Conclusion

In this work, Vis/NIRS combined with feature selection algorithm VISSA and ANN has been used as a simple, non-destructive and environmentally friendly approach to predict soluble sugar content (glucose and fructose) and pH of loquats and thus gain an idea of their maturity. Feature selection was used to select informative wavelengths from 1000 extracted by the Vis/NIRS technique. It significantly improves model performance and helps to avoid major machine learning problems such as over-fitting and under-fitting.

Moreover, this technique reduces computation time and provides a better understanding of the model. ANN was established to predict pH, glucose and fructose in loquat samples. The statistical parameters obtained are very satisfactory, with prediction determination coefficients close to 1 and low errors. Analyses were performed in reflection mode, within the spectral range 500–1000 nm on 149 samples.

This study concluded that combining Vis/NIR spectroscopy with feature selection and ANN can be used to predict the three key maturity characteristics of loquat with good prediction accuracy. The combination of these methods demonstrated its high prediction power with no data preparation. The recommended approach can be used as a new measurement protocol to assess loquat quality, by determining its three characteristics. In addition, it can be used as part of quality control strategies, enabling rapid and non-destructive quality analysis.

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Contribution of Artificial Intelligence in Entrepreneurship: A Systematic Literature Review

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Abstract. Increasing digitization and advances in artificial intelligence (AI) are bringing new jobs or business models. There is a gap in current research on the impact of digitalization on performance. This systematic literature review (SLR) seeks to enhance our understanding of this field and provides a logical evaluation of existing contributions. It aims to review research on the way artificial intelligence impacts performance. The findings show that artificial intelligence has a significant impact on business, especially a positive impact on entrepreneurs. The present study provides policy signal makers and entrepreneurs with a comprehensive view of key concepts, enabling them to understand the current state of artificial intelligence in the industry.

Keywords: Entrepreneurship · Artificial Intelligence · Entrepreneur · SLR

1 Introduction

The present-day generation of the Fourth Industrial Revolution (four IR), known as Industry 4.0, integrates superior technology like AI to create wise structures with fully digitalized manufacturing [1]. AI permits faster and extra green techniques, fostering commercial growth [2] while necessitating organizational adjustments [3]. Hence, AI performs a vital function by allowing machines to surpass human abilities, releasing up time for more human and much less computerized obligations [4]. However, coping with the blessings and drawbacks of AI, together with task losses and economic disparities, stays vital [5].

Facing these demanding situations, research specializes in the intersection of AI and entrepreneurship. We conduct a SLR to recognize how entrepreneurs adopt AI, pick out developments and gaps, and suggest future studies instructions [6]. This take a look at is especially important in the current context of the COVID-19 pandemic, which quickens the transition to digitalization and gives marketers unique possibilities for digital transformation thru public funding [7, 8]. The impact of AI on entrepreneurship

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requires thorough exploration to grasp its implications and stimulate entrepreneurial innovation and increase.

This work is prepared as follows: in Sect. 2, we will discover the relationship between AI and entrepreneurship, highlighting how entrepreneurs undertake and adapt AI technology to support their ventures. Next, the method hired to conduct this analysis might be outlined, elucidating the standards for observe selection and information analysis strategies. In the following segment, the findings of our cluster analysis could be offered, figuring out key topics and rising traits inside the reviewed literature. Following this, a conceptual framework designed to interpret the impact of AI on entrepreneurship will be added, and avenues for destiny research can be proposed. Finally, our paper will be concluded by means of summarizing the findings of our look at and acknowledging its limitations, whilst the importance of in addition research on this place to better understand the consequences of AI on entrepreneurship might be underscored.

2 Entrepreneurship and Artificial Intelligence

The adoption of emerging technologies like Big Data Analytics and AI is increasing [9]. Entrepreneurs want to evolve to modifications, and those gear can power new business ventures [10]. Data, combining records and knowledge, is vital for creating marketplace possibilities [11]. AI and Big Data are crucial in present day business, with exploiting statistics being a good-sized task in statistics science [12]. These technologies may also either replace entrepreneurs or foster a symbiotic dating with them [13].

2.1 Entrepreneurship

The digital revolution has converted how fee is generated [14]. This has caused a surge in studies on the effect of digital components on business models [15]. As organizations undertake digitalization [9], understanding its role in business boom and marketplace positioning is important. Entrepreneurs must use superior technology to benefit an aggressive side amid dynamic market modifications and international competition [16]. It is essential to recognize both the blessings and risks of these technologies. Integration of AI in Higher Education Institutions is relevant for fostering entrepreneurship [17].

Analysts along with [18] have investigated why entrepreneurs adopt AI in virtual entrepreneurship. Interest in AI is growing because of its transformative effect on entrepreneurship [19]. AI reshapes techniques and strategies by using facilitating information get admission to and series [20]. This record evolves into insightful clever facts [21], catalyzing the development of novel entrepreneurial ideas [22].

2.2 Artificial Intelligence

AI is a pivotal pressure using technological and financial advancement [23], providing new enterprise possibilities [24]. Scholars like [25] highlight that AI imbues computer systems with intelligence much like human idea approaches. Amid the contemporary societal paradigm shift, digital tools are catalysts for increase and progress, transforming enterprise sports [26]. Examining how AI will shape global productivity and numerous

facets of existence inside the near destiny is imperative [27]. AI, recognized as one of the maximum present-day technologies [28]; [29] has profoundly stimulated the global financial system and its evolution. AI, as an interdisciplinary technology, combines cognitive methods with machine mastering and emotion recognition [30]. This integration spans laptop technological know-how, logic, and other fields, impacting essential capabilities like natural language processing [31], and facilitating human-laptop interaction, facts management, and choice-making. AI complements commercial enterprise techniques [32], allowing enterprises to refine their desires and methodologies, enhancing service first-rate, productivity, and cost-efficiency [33]. Designed to be adaptive, AI targets to offer custom designed answers that meet person requirements. However, demanding situations including scalability, the shortage of AI professionals, and restricted public know-how of AI's broader implications hinder its seamless integration into commercial enterprise operations and adoption with the aid of enterprise leaders [34].

3 Methodology

3.1 Review Protocol

This SLR follows the guidelines established by [35]. The objective of the research identified in this framework is to accurately examine the research area encompassing entrepreneurship and AI. Furthermore, the aim is to systematically collect and integrate existing relevant studies as much as possible. Thus, the key research question, "What is the contribution of AI to business?" Our research protocol aims to provide answers.

To address this question, the most relevant scientific papers from the past should be selected. Thus, the inclusion and exclusion criteria for these previous studies should be established.

3.2 Inclusion and Exclusion Criteria

The collection comprises research papers that concentrate on two primary categories of terms: one associated with "entrepreneurship" and the other with "AI ". Concerning the former, we incorporated various forms linked to entrepreneurship, encompassing the terms "entrepreneurial", "entrepreneur". Regarding the latter, we encompassed the acronym "AI". The final search query employed is: ("entrepreneur" OR "entrepreneurship" OR "entrepreneurial") AND ("artificial intelligence" OR "AI"). The review is confined to English journal articles published until December 31, 2023, across four databases—Scopus, Web of Science, Emerald, and Elsevier—searching for terms in the title, abstract, and keywords of the articles. Below, more details are presented:

Inclusion Criteria
From 917 papers identified until December 31, 2023, the articles are chosen according to the inclusion criteria below:

- Published until December 31, 2023.
- Published in academic publishing (journals, databases, etc.)
- Published in Scopus, Web of Science, Elsevier and Emerald.

- Written in English.
- Dealing explicitly or implicitly with Entrepreneurship and AI.

Exclusion Criteria
The following forms of papers are excluded:

- Not written in English (articles written in French, Spanish……etc., are neglected).
- Not Published in Scopus, Web of Science, Elsevier and Emerald.
- Not dealing explicitly or implicitly with Entrepreneurship and AI.
- without clear methodology.

3.3 Sources of Data and Research Strategy

Our search changed into initiated through getting into our keywords into the maximum famous search engines. The Specific Search Strategy has been formulated as follows:

(Entrepreneurship OR entrepreneurial OR entrepreneur) AND (artificial intelligence OR AI).

The research recognized 917 papers using keywords formerly cited within the Specific Search Strategy. In the first example, selected assets are searched throughout four databases: Scopus, Web of Science, Elsevier, and Emerald, in which 437 papers are discovered. Then, we have diagnosed and eliminated reproduction studies, resulting in 102 papers being removed. By the cease of this stage, there will be 335 papers. The third step worried reading all of the abstracts, and eventually, we removed 270 studies beside the point to the research. In the cease, there have been sixty-five articles.

3.4 Data Extraction Strategy

During this method, various critical factors were extracted, such as the title of every look at, creator names, guide info, united states of america of foundation, year of publication, and the supply of every take a look at. This process goals at gaining a thorough information of the examined research papers.

Once these elements are extracted, a meticulous analysis and synthesis of the results from each observe are proceeded with. This step includes an intensive assessment of the method, the statistical data, the conclusions, and the distinct arguments presented in every selected research painting. The aim is to discover developments, similarities, and great differences among the research, thereby supplying a complete and coherent evaluate of the research area.

In precis, the in-intensity evaluation is going beyond mere extraction of simple information; it additionally contains a crucial evaluation of the results, contributing to the rigor and relevance of our SLR.

4 Results of the Systematic Literature Review

4.1 Evolution of Scientific Production

The proliferation of digital tools and the process of digitization have grown exponentially in recent years. A notable trend from 2017 is particularly apparent.[36] examines research on the impact of human capital and AI, while [9] analyzes the impact of environmental improvements. In addition to the impressively growing literature in this area,

a contemporary trend has emerged to extend the analysis of research topics beyond the technology itself to include assessment of implications and social impacts (Fig. 1).

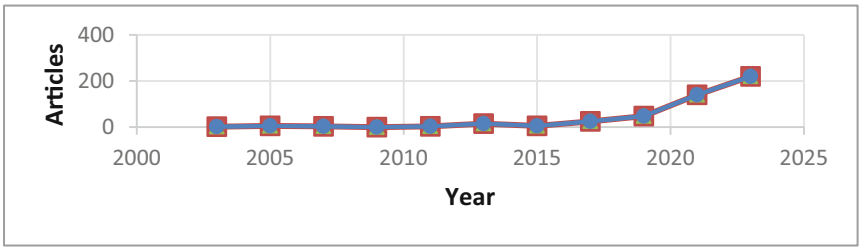

Fig. 1. Annual Scientific Production (Source: compilation based on several relevant articles)

4.2 Citations Affiliations

The institutions with the highest number of citations are determined by focusing on the associations of authors who make significant contributions to scientific advancement (Fig. 2). Notably, Harvard University, University of Sydney, Jilin University, The Indian Institute of Technology and the University of Queensland stand out as major sponsors.

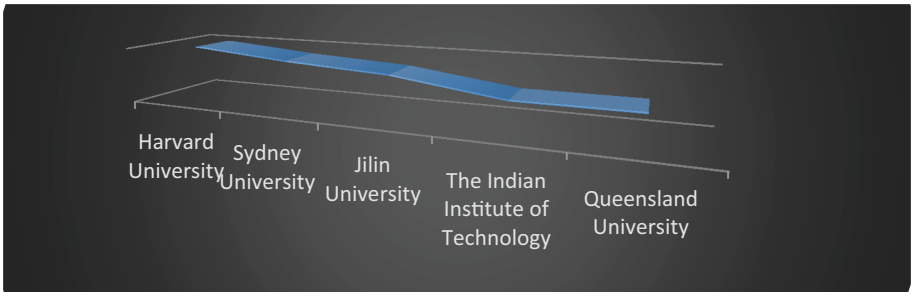

Fig. 2. Affiliations of the authors making the scientific contributions (Source: Blanco-González-Tejero, C., Ribeiro-Navarrete, B., Cano-Marin, E., & McDowell, W. C.(2023).)

4.3 Citation Analysis by Authors

Among prominent authors in the field of performance and AI, special reference is made to [5, 9, 36, 37]. In particular, [5], emphasizes the skepticism about the future impact of AI technology and its potential to shape utopian or dystopian worlds. [36] links social entrepreneurship to human capital and AI in an Industry 4.0 context.[9] emphasizes the importance of big data and artificial intelligence for business improvement in terms of impacts from business intentions and environmental trends (Fig. 3).