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Roadmap to Systematic Understanding of Artificial Intelligence Technology Development and Implementation: A Narrative Review of Frameworks, Platforms, Scenarios of Use and Empirical Guide

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Abstract

One of the most significant inventions that have influenced both our daily lives and industrial operations is artificial intelligence (AI). Its quick development portends revolutionary effects in several areas, from cutting-edge businesses to regular people's lives. The current literature on technical understanding of what is required for AI development and implementation is fragmented across the existing studies. Nonetheless, there is still a shortage of systematic knowledge and comprehension regarding the AI implementation frameworks, techniques, tools, and scenarios of use (SoU). To contribute to the ongoing research efforts on the subject, the study conducted a narrative review using published resources from scholarly databases, such as IEEE, ACM, and Science Direct. 115 publications were found in well-chosen academic databases by the search to be eligible for further analysis intended for the study. The paper proposed an empirical guide towards implementing AI projects by AI stakeholders. The overall impact of the paper is that it emerges as a powerful tool for directing the whole AI continuum by both novice and experienced AI development schemes and stakeholders to approach the roadmap of developing and implementing AI initiatives. The paper offers systematic provision of direction towards any thought aiming at developing and implementing AI solutions.

1. Introduction

Artificial Intelligence (AI) is becoming increasingly important in several industries, including banking, transportation, education, electronics, manufacturing, and electronic commerce, as a result of the quick development of creative, adaptable, and web-based technologies [1]. The idea of AI, which was formerly thought to be only a fiction, is now a necessary component of our everyday lives. The world, as we know it, is changing faster than ever because of AI [1, 2]. AI is influencing many facets of our lives, from news aggregators to self-filter. Soon, voice-activated personal assistants and self-driving automobiles will be commonplace. Big data (BD) and more potent computers are expected to fuel this industry's exponential growth. Knowing the vocabulary and resources accessible to address issues and develop new applications is crucial for anyone interested in computing technology, be a researcher, practitioner, student, or any combination of these.

AI frameworks, tools, and approaches that can simulate intelligent behavior can now mimic human-like decision-making and performance [3]. AI, which is commonly defined as the science that allows computers to function independently, has enormous potential to improve systems [4-6]. It is an area of computing technologies that are motivated by, but frequently operates in opposition to, how humans see, learn, reason, and behave with their bodies and senses. Although these technologies are amazing, they are extremely tailored to particular jobs and usually need a lot of research and careful development over an extended period [6-9].

The problem under investigation is that the current literature on the subject is fragmented across the existing studies. Without a systematic literature roadmap to AI endeavors and understanding, there will be a low widespread of design, development, implementation, adoption, acceptance, and usage of AI technology across most parts of the world. The study was guided by the following research question (RQ):

What are the AI development frameworks, techniques, tools, and scenarios of use that are commonly available in the literature?

The rest of the paper is organized as follows: the literature is briefly represented in section two, and the study methodology is outlined in section three. Section four shows the results and discussion of the study. Finally, section five highlights the conclusion of the study.

2. Literature Review

2.1 Fundamentals of AI

It is imperative to define the term AI precisely as it is general word used to describe a broad area of study. On the one hand, it covers broad ideas like perception and learning [10]. On the other hand, AI is used for specialized jobs like driving cars, proving mathematical theorems, playing chess, and diagnosing illnesses [11, 12].

It is challenging to come up with a universal definition of AI because of its diversity and dynamic nature. The current definitions concentrate on rationality, optimal performance, or human performance. AI is the "study of how to make computers do things which, at the moment, people do better" [13]. Natural language processing (NLP), knowledge representation, automated reasoning, machine learning (ML), computer vision (CoV), and robotics are all necessary for a system to behave human-like [13, 14]. As can be shown, depending on how the challenge is defined, AI encompasses a wide spectrum of technologies [15, 16]. Therefore, this paper only focuses on essential roadmap facets related to successful AI technology development, implementation, adoption and acceptance, and transition for any party interested in the technology in question.

2.2 The current trends and future of AI

AI has not advanced much until recently, especially in the 2020s [23, 24]. The following are a few prevalent patterns in the AI fields: AI algorithms that use predictive analytics are able to examine data and forecast future occurrences or results [25]. This can be used in a variety of industries, including retail (demand forecasting) and finance (cash flow estimates). One may anticipate future profits and get a real-time analysis of the revenue with tools like Cash Flow Frog.

Additionally, pattern recognition is employed in NLP, anomaly detection (fraud identification), and picture recognition (self-driving automobiles) [26]. For instance, Tesla uses AI to scan the environment and react to traffic using cameras, radars, and ultrasonic sensors [27]. Another development is generative AI. This technology creates new data like language, music, or images based on patterns already in existence. One example is the creation of lifelike photographs of fictional persons. Based on word prompts, programs like Dall-E and Midjourney can provide beautiful illustrations [28].

In addition, conversational AI algorithms known as chatbots can be utilized for teaching and customer service by mimicking human speech [29]. For example, companies might incorporate chatbots into their websites and applications so that users can ask basic inquiries of the AI bot instead of waiting for a customer service representative. Virtual assistants: AI-powered assistants, such as Siri and Alexa, can understand and respond to voice instructions, helping with tasks like making appointments and controlling smart home products.

Finally, recommender systems: AI algorithms analyze a user's prior behavior and interests to suggest films, books, and other stuff. For example, over-the-top (OTT) services like Netflix and Hulu use data on watching preferences, such as the genres and duration of content to watch, to suggest new films or Television (TV) shows.

One potential AI future is super-intelligence, where machines surpass human intelligence in numerous areas. Although it sounds like a sci-fi movie, most AI research companies, including big tech companies like Google and Microsoft, are actively working toward this objective. The following common patterns could result from future advancements in cross-cutting AI [30, 31].

Artificial General Intelligence (AGI): In this case, AI is on par with human intelligence and capable of coming up with novel solutions to challenges [32]. This covers artistic endeavors like crafting a novel from the beginning or producing poetry with the same emotional depth as works by humans, as well as scientific endeavors like formulating fresh theories and planning investigations [33].

Super intelligence: This advances it to the point where AI surpasses human intelligence in solving some of the most pressing global issues, such as hunger, sickness, and climate change, as well as optimizing systems that are beyond human comprehension [34, 35].

AI singularity: Consider a time when the advancement of AI will be beyond our capacity to manage or comprehend it. The singularity is a metaphor for this explosive rise in intellect [36, 37]. Some think the singularity could occur if AGI is achieved. With its exceptional capacity for problem-solving, an AGI might quickly boost its intellect, causing a "knowledge explosion," and take over the entire planet.

Although singularity currently seems unlikely, a lot of people are concerned about it, and Sam Altman of OpenAI has said that he is afraid of what might happen if AI becomes too advanced [36, 37]. However, none of these "futures" are concrete and may take years to materialize. AI-powered diagnostic centers, statistical analysis, and self-

driving cars are just a few examples of how AI is expected to revolutionize healthcare, research, and the Internet of Things (IoT) [38].

When considering the future of any significant activity or event in our environment, people must consider several pertinent stages and factors that will affect the activity, such as its current state, its constituent parts, the impact the activity currently has on society, and how the activity will develop in the future and the ensuing effects on human life [39]. Since AI plays a big role in both societies at large and in human life, it is evident that this is an important consideration for AI.

Regarding the current situation and factors that are influencing it, the quick advancement of computerization, the accessibility of hardware, software, and gadgets, as well as the high processing speeds, have all contributed to AI's rise to prominence as a field of study aimed at improving human existence. Big data can be analyzed by ML and DL models developed with AI to provide insightful information for advancement. Although the camera photos and sensor capacity are currently good, they are expected to get better in the future. Better technology and algorithms are being developed for this goal through ongoing efforts by research groups and technical universities [40]. This is demonstrated by the fact that AI is being covered in many PhD programs and that a sizable number of patents are being filed every day.

Billions of dollars are being spent on updating and implementing AI capabilities by major IT behemoths like Google, Microsoft, IBM, Apple, and Amazon [41]. Regarding AI's existing effects, they are easily observed in our daily lives. By altering and analyzing pertinent data, industries use AI for production, inventory management, quality control, and maintenance [42]. AI has been used in the healthcare industry to create novel medications, detect illness beginning and progression, and assist in disease prevention [43, 44].

AI is being used by educational institutions to introduce new, in-demand courses. It is hard to identify an industry nowadays where AI is not being applied [45-49]. Certain fields, such as space exploration, aviation, disaster management, and financial transactions security, have adopted AI at a very advanced level, while others are still in the early phases.

2.3 Related Works

Table 1 summarizes the related works to the subject under investigation. The summary depicts key aspects of the relevant existing work: issues investigated, approach deployed, gaps and strengths of the study as well as the source of the study. It can be observed that three existing related works deployed reviews during the investigation, the other one used bibliometric analysis surveys, and the last one applied survey. The current study applies narrative review to provide insight into the subject under investigation. The gaps and strengths of each study are also highlighted in Table 1.

3. Methodology

To evaluate the roadmap to a systematic understanding of AI technical development and implementation facets (frameworks, techniques, tools, and SoU/applications/use cases), the study adopted a narrative review [55, 56]. The narrative review methodology to literature review studies is prejudiced toward a qualitative interpretation of past knowledge to review the body of existing literature [57]. This decision was made because, while it aims to synthesize or summarize existing literature on a certain subject, it does not look for cumulative knowledge or generalizations from the evaluated material [57, 58]. Rather, the review frequently takes on the responsibility of compiling and analyzing the literature to support a specific viewpoint [58, 59]. Therefore, to convey a point,

Table 1. Prior reviews and their approaches.

Issue	Approach	Gaps and Strengths	**Ref.**
Business models of AI: Role of AI in sustainable business models	Bibliometric analysis and review	Need to adopt a quantitative approach to review AI research More systematic review for our understanding of AI in business	[50]
Business value of AI in information systems implications	Review	Lack of consensus around the definition and themes of AI Need for review on technological, performance, and contextual aspects of AI	[51]
How to effectively integrate AI and organizational strategy	Survey	Insight into new AI tools to align with business strategy and contextual needs of the organization	[52]
Frameworks and factors influencing acceptance of AI	Review	Need to examine the impact of AI on the level of analysis Inconsistency in the definition and operationalization of themes of AI	[53]
Artificial intelligence research: A review of dominant themes, methods, frameworks, and future research directions	Review	The facets covered here (themes, methods, frameworks) are non-technical.	[54]
The Roadmap to Systematic Understanding of Artificial Intelligence Technology Development and Implementation: Frameworks, Platforms, Scenarios of Use and Empirical Guide: Narrative Review	Narrative Review	The aspects (frameworks, techniques, tools, SoU) covered are technical towards AI development and implementation/coding.	

reviewers may choose to limit or omit particular studies. Like in many fields, several narrative reviews take this kind of unstructured approach in the specific domain [60]. Notwithstanding these concerns, this kind of review can be quite helpful in compiling and synthesizing a large body of literature in a particular field of study. Its main goal is to give the reader a thorough framework for comprehending what is currently known while emphasizing the need for new research [61]. Furthermore, narrative reviews occupy a special and privileged place in scientific research as well as serving a vital scientific function, but very few resources help people learn how they can be written [62].

A search of the literature from 2015 to 2024 was conducted from the IEEE, ACM, and Science Direct electronic scholarly databases to write this narrative review. The search strings used were "AI technology development frameworks," "AI technology tools/techniques," "AI technology

scenarios of use/applications," and "AI technology development and implementation guide." The publications were written in the English language during the mentioned period for various studies, including empirical, theoretical, observational studies, randomized, and review articles, among others, as it is a narrative review. Non-English publications were not considered for the study. The search retrieved 40 publications from IEEE, 32 publications from ACM, and 30 from Science Direct, making a total of 102 publications. Scholarly databases were searched using key words: "AI technology implementation," "AI technology development and implementation" and "AI implementation guide". Key information was added from cross-references, the studies that were retrieved were thoroughly examined, and duplicates were eliminated. The included studies met the eligibility criteria if they provided a general overview of the aspects involved in comprehending the creation and deployment of AI, including methods, resources, and software. In the end, 115 publications were chosen to be included in the narrative evaluation. The review was organized under the following headings: (1) AI development and implementation frameworks; (2) AI development and implementation techniques/tools; (3) AI technology scenarios of use and applications; and (4) empirical guide to AI technology development and implementation.

The process of writing up this narrative review was distilled into a sequence of five simple steps. The first four steps are similar but different for a narrative review compared with a systematic review, reflecting the key differences between these review types [63, 64]. The steps that were executed for the realization of the current review are as follows:

i. Step 1 was to define a topic and the intended audience for the Review [63-65] “Roadmap to Systematic Understanding of Artificial Intelligence Technology Development and Implementation: Frameworks, Platforms/Techniques, Tools, Scenarios of Use and Empirical Guide: Narrative Review”

ii. The second step was to Search and “Re-Search” the Literature [65]. The task here was to identify the most relevant literature in the selected topic area, generally via keyword searches on relevant electronic databases,

iii. The third step was to perform a Critical Reading of the Selected Literature. The task was not only to summarize the relevant literature but to also analyze it, provide a critical discussion on it, and identify methodological problems in reviewed studies or knowledge gaps.

iv. The fourth step was to find a Logical Structure for the narrative review [65]. The Task was to write up the review in a straightforward, effective way.

The fifth and final commons step in "writing" review whether it is narrative or systematic is to make use of feedback in revising the review before formal submission to a journal. The Task was to ensure the review is clear and accurate; that is, that it does not have any ambiguities, inaccuracies, or inconsistencies.

4. Results and Discussion

4.1 AI development and implementation frameworks

The literature and categorization of the AI development frameworks available in the literature were made clear by the narrative review. Effective AI model creation, testing, and deployment depend on the frameworks and libraries (Table 2) of the AI development process. From data preparation to

model deployment, these tools support developers at every step [66].

Numerous frameworks for creating algorithms have been developed as a result of the boom in AI research and development, which will assist practitioners, academics, and developers in getting started [67]. Even though AI technologies are already employed in several industrial sectors, there is an abundance of AI development frameworks that necessitate the methodical organization of knowledge surrounding them. AI has become a vital tool for software development in today's hectic tech world. It enables applications to do functions that were previously thought to be limited to humans, including producing and comprehending human language, finding patterns in data, and coming to wise conclusions. AI is changing software development, whether it is through chatbots, recommendation systems, image recognition, or NLP.

AI Development Frameworks and Libraries are pre-assembled sets of resources and technologies that make it easier to create applications using an AI foundation. These frameworks serve as a foundation, making it easier to apply ML and DL algorithms and develop intelligent software.

With a strong technical background, developers, data practitioners, and researchers may wonder how to utilize AI's potential best. To address that, this review examined many AI frameworks that are now accessible in the literature, investigated pertinent frameworks and libraries, and covered other crucial topics, including selecting the best AI development framework for a certain AI project.

TensorFlow: This is extensively utilized in production AI development and implementation. Its main application programming interface (API) is based on Python, and it also provides APIs for several other languages, including JavaScript, C++, and Java [68-72]. TensorFlow is optimized for Intel CPUs through a partnership between Intel and Google. New features and optimizations are frequently made accessible in the Intel® Extension for TensorFlow before being included in the open-source TensorFlow [70]. These applications frequently call for enormous datasets and deep neural networks, which might cause computational constraints. Before pushing its most recent features and improvements into the open-source TensorFlow, Intel first releases them in the Intel® Extension for TensorFlow [71].

TensorFlow may be extended by developers with a few lines of code [72]. To optimize the TensorFlow framework for Intel hardware, Intel also collaborates closely with the open-source TensorFlow project [73]. Together with the extension, these TensorFlow enhancements are part of the whole package of Intel® AI and ML development resources. In 2011, Google Brain, an internal initiative, gave birth to TensorFlow. In 2017, it was made available to the public as an open-source DL neural network that is capable of operating on several GPUs and CPUs. Similar to how humans learn and reason, it is used to train neural networks to recognize and understand patterns and correlations (tensorflow.org). The Google team developed the well-known software library TensorFlow, which blends optimization methods with computational algebra to simplify the calculation of many mathematical assertions. Popular DL framework TensorFlow is capable of training and executing deep neural networks for a wide range of DL tasks, including word embedding, picture recognition, and handwritten digit categorization.

PyTorch: This Python-based framework for AI and ML is well-liked for use in both production and research [74]. To speed up PyTorch on Intel CPUs, Intel provides optimizations to the PyTorch Foundation. Before being added to the open-source

PyTorch, the most recent improvements and usability additions are initially made available in the Intel® Extension for PyTorch. DL applications that push the boundaries of hardware resources through compute-intensive training and inference frequently employ this open-source package [75]. Before pushing its most recent improvements and optimizations into open-source PyTorch, Intel first releases them as part of the Intel® Extension for PyTorch [76]. Using just a few lines of code, one can use Intel Extension for PyTorch to perform the following: add own performance customizations using APIs; take advantage of the most recent Intel software and hardware optimizations for PyTorch; and automatically mix different precision data types to reduce the model size and computational workload for inference. Additionally, to enhance the PyTorch framework for Intel hardware, Intel collaborates closely with the open-source PyTorch project [75, 76].

JAX: Developed for sophisticated numerical computations on high-performance devices such as GPUs and TPUs (tensor processing units), this open-source Python library [76]. In addition to automatic differentiation and support for NumPy functions, it offers a composable function transformation mechanism for neural network construction and training. TensorFlow's Intel Extension allows Intel processors to support JavaScript.

DeepSpeed: This DL optimization software suite is available as an open-source project [77]. By managing heterogeneous memory, automating parallelism, improving communication, and compressing models, it speeds up the training and inference of huge models. According to Agarwal et al. [78], DeepSpeed is compatible with Intel CPUs, Intel GPUs, and Intel® Gaudi® AI accelerators.

Apache MXNet: With imperative and symbolic programming, this open-source, lightweight deep-learning framework is intended to provide efficiency and flexibility [79, 80]. Intel optimizations are integrated into MXNet to provide optimal performance on Intel® Xeon® Scalable CPUs.

PaddlePaddle: Baidu's open-source deep-learning Python framework is renowned for its scalable and user-friendly features [81]. Constructed with the aid of Intel® one API Deep Neural Network Library (one), this well-liked framework offers quick performance on Intel Xeon Scalable processors along with an extensive toolkit to assist AI developers [81, 82].

Scikit-learn: According to [83], this is one of the most used Python packages for data science and ML. Numerous scikit-learn algorithms can be seamlessly accelerated on Intel CPUs and GPUs, both single- and multi-node, with the help of Intel® Extension for Scikit-learn [84]. This NumPy, SciPy, and Matplotlib open-source package for Python is built upon them. It is the most reliable and effective machine-learning library for Python. Through a Python interface, it provides a range of efficient tools for statistical modeling and ML, including dimensionality reduction, clustering, regression, and classification.

ONNX (Open Neural Network exchanged): Facebook and Microsoft made this announcement in September 2017 [85]. The purpose of ONNX is to facilitate the transfer of DL models between the frameworks that created them. The goal of this project is to facilitate developers' use of numerous frameworks [86].

Caffe: Berkeley AI Research (BAIR) developed Caffe in 2014, and it quickly gained traction in scholarly investigations. Convolution nets are used in this DL framework (caffe.berkeleyvision.org) [87]. Berkeley Vision and Learning Center (BVLC) is the home of the deep learning framework Caffe (Convolutional Architecture for Fast Feature Embedding). DL experiments are made easier by

Caffe [88]. It has bindings for Python and Matlab and is developed in C++. Because it supports GPU, it works well in production scenarios that use deep neural networks. Additionally, it is compatible with CPU-based kernel libraries such as Intel Math Kernel Library (Intel MKL), CUDA Deep Neural Network Library (cuDNN), and NVIDIA. In 2017, Facebook launched Caffe2, a commercial version of Caffe [89]. It was developed to make caffeine lighter and to address issues with its scalability. It enables quantized computations, deployment, and distributed computing.

Keras: This advanced neural network of APIs runs on top of TensorFlow. Easy to use and quick to prototype, but it might not have all the more sophisticated capabilities [90]. Python is the foundation of the open-source DL system Keras. Because Keras runs on top of open-source machine libraries like CNTK, TensorFlow, and Theano, it is cross-platform interoperable [91, 92]. It is an easy-to-use high-level framework that hides the backend activities and allows us to quickly build a neural network model that operates on both the CPU and the GPU [92, 93].

Cognitive Toolkit (CNTK): This is an open-source DL toolkit that uses a directed graph to represent neural networks as a sequence of computing steps. According to Chung et al. [94], it is meant to support datasets and algorithms of a commercial caliber. This library offers model descriptions and machine-learning techniques to facilitate the management of segregated computation networks. Additionally, it is capable of building, training, and using a range of deep neural networks.

Theano: Rapid numerical computation on the CPU or GPU is possible using this Python library, which is based on NumPy [94, 95]. Using wrapper libraries to make the process easier, or building DL models directly, is a crucial Python DL toolbox [96].

It is important to note that in the current environment when creating AI-driven software, developers, data practitioners, and researchers increasingly use related frameworks and libraries to save money, time, and resources. The review determined that it is worthwhile to examine in brief the primary rationales for the critical role AI development frameworks play in improving the software development process [97, 98]. Among the causes are the following:

1) Cost-effectiveness for its businesses AI frameworks is an economical solution for IT enterprises involved in creating customized software applications. These frameworks play a major role in cutting development costs by eliminating the need for manual coding and allowing developers to use pre-built components [99]. Using this method enables companies to quickly develop complex apps that are customized to meet their unique needs. By utilizing AI and ML, businesses can create software solutions that are more effective than those created using more conventional development techniques [100]. Encouraging the flow of app development (it is important to consider frameworks' capacity to optimize the development process before selecting one).

2) These frameworks provide developers with the ability to concentrate on addressing particular issues instead of wrangling with the complexities of implementing AI, by providing them with pre-implemented algorithms, data handling utilities, and optimization strategies.

3) Time-saving opportunities: AI frameworks ease the development, testing, and deployment of applications, which saves a great deal of time in current software development [100-102].

Table 2. The summary of the common AI development and implementation frameworks and libraries.

AI Development and Implementation Frameworks	Framework Summary Statement
PyTorch and TensorFlow	Outstanding for projects using DL. PyTorch provides flexibility, whereas TensorFlow prioritizes scalability.
Scikit-Learn	Preferred for conventional ML jobs
Keras	An easy-to-use gateway to DL
XGBoost	Excels in issues with organized data.
Caffe and Caffe2	With the release of the Caffe 2 version, the best option for computer vision. It was developed to allay worries about Caffe's scalability and to make it lighter.
DeepSpeed	This software suite for DL optimization is open source
MXNet	Offers efficiency and scalability
Theano	Although it is no longer being developed actively, it might still be useful in some educational settings.
Lang Chain and OpenAI	Great choices for large language models (LLM)
PaddlePaddle	Baidu's open-source DL Python framework is renowned for its scalable and user-friendly features.
Hugging Face	Useful for NLP
JAX	Designed for sophisticated numerical computations on high-performance devices such as GPUs and tensor processing units (TPUs), this is an open-source Python library.
ONNX	The purpose of this interchange standard is to enable the transfer of DL models between the frameworks that were used to construct them.
CNTK	It is meant to work with datasets and algorithms of a commercial caliber.

4.2 AI Development and Implementation Techniques /Platforms

The narrative evaluation found the current state of the art and categorized the AI development techniques that are frequently seen in published works (Table 3). Although AI techniques are now applied in several industrial industries, there is a deluge of AI development techniques that necessitate the methodical organization of knowledge and comprehension around them.

ML: Using historical data, ML algorithms can predict a patient's likelihood of developing a specific illness. It should be common to see the term "AI/ML" in job descriptions. This is because most firms' AI research teams rely heavily on ML [103]. An AI engine is fed a lot of data via ML, along with precise instructions on how to evaluate and spot patterns in the data. This aids in the development of algorithms that forecast human behavior patterns [104]. The two core components of ML are supervised and unsupervised [105]. The former uses labeled data to train AI algorithms. An email provider might, for instance, use data categorized as spam and non-spam to train their spam filtering feature. However, unsupervised learning works with disorganized, unlabeled data, and AI performs the labor-intensive task of classifying the data and identifying patterns [106].

DL: Consider it as training a computer to identify significant traits such as atypical patterns in patient data or tachycardias in cardiac rhythms [107]. Compared with ML, DL employs intricate, multi-layered neural network architectures to automatically recognize and extract complex attributes from raw data [108, 109]. This makes it particularly appropriate for positions involving the recognition of medical images and natural language understanding [110].

NLP: Having an informed assistant who can read and understand all of the important correspondence and data, ensures that nothing important is missed [111, 112]. One common AI method that focuses on language is NLP. NLP enables AI engines to produce human language and make human-machine interactions less robotic and more human by understanding the grammar, syntax, and diverse semantics of a language's linguistic structure [113]. NLP is used in AI systems such as ChatGPT, Siri, and Google Translate, which are virtual assistants. Sentiment analysis, NER, and art-of-speech (POS tagging, text preparation) are additional NLP dimensions.

Reinforcement Learning (RL): In exchange, the environment sends out a reward signal, which may be negative or positive. Throughout the interaction, the agent's goal is to maximize the (anticipated) cumulative reward signal [114]. A computer learns by trial and error in reinforcement learning (RL), much like humans learn to ride a bike by trying and adjusting their actions [115]. In the context of healthcare, the computer learns continuously through feedback and medical data. It can provide recommendations for patient care based on this knowledge [116].

Anomaly Detection (AD): In AI, anomaly detection refers to a method for locating anomalous patterns or outliers in a dataset that differ from a typical baseline [117, 118]. These anomalies may indicate an issue with digital system performance, an unforeseen system malfunction, security breaches, or an uncommon event of interest [119]. By examining historical data, AD determines what values, such as heart rate, temperature, or other vital indicators, are usual for that individual [120]. AD continuously monitors these indicators, and it sounds an alarm whenever it detects anything noticeably out of the ordinary [121, 122].

CoV: Computers can now analyze and comprehend the visual environment thanks to this AI technology [123]. The computer receives media from cameras or scanners, which it then processes using DL neural networks and image-processing tools to improve visual comprehension [124]. This is important for self-driving cars since they use the images that are transmitted to the AI engine of the vehicle through the cameras to traverse roadways and identify objects.

Table 3. Summary of the common AI development and implementation techniques.

Technique	Description	Ref.
ML	ML uses AI algorithms to learn from the data points it collects. It may be taught to recognize patterns and trends in data.	[125]
DL	DL algorithm use is a potent AI approach. DL is used to train computer systems to recognize and comprehend complicated patterns in data.	[126]
NLP	The terms and expressions included in messages and notes are among the natural languages that NLP algorithms can understand and analyze	[127]
RL	Reinforcement learning (RL) is a class of AI under ML issues that assumes an autonomous agent exploring an environment, where the agent observes information about its present state and takes action.	[128]
AD	In AI, anomaly detection refers to a method for locating anomalous patterns or outliers in a dataset that differ from a typical baseline.	[129]
CoV	Computers can now analyze and comprehend the visual environment thanks to this AI technology.	[130]

4.3 AI Tools

A tool is a physical object used to accomplish a task and is a specific instrument or software. AI

tools will be expected to revolutionize modern processes and support all significant advancements in the years to come. In all of the main industries, it is probably going to be an indispensable assistance [131, 132].

Table 4. Summary of common AI tools reviewed.

Tool	Ref.	Description
ChatGPT	[135]	NLP is used by Open AI's ChatGPT to generate linguistic conversations that seem human. It provides a thorough solution and adheres to directions. ChatGPT offers assistance in a variety of methods and regenerates the solutions if desired outcomes are not attained.
Textio	[136]	This AI talent acquisition solution offers impartial, actionable, and fair performance appraisals along with excellent feedback.
DALL-E	[137]	A neural network named DALL-E was trained by Open AI to produce images from text. Transformer language model DALL-E is trained to create all tokens sequentially, given text and image input as a single stream of data with up to 1280 tokens.
Midjourney	[138]	It makes use of a Midjourney bot for one-on-one conversations, Discord for prompt writing and image creation, and a user guide for further information regarding versions, parameters, and other topics.
Paradox	[139]	This conversational recruiting technology handles 99 percent of the employment process automatically, including scheduling interviews, issuing offers, conducting background checks, and completing onboarding documentation.
Tome	[140]	Storytelling has arrived in its future. We may easily generate narratives by using Tome. It helps create presentations by converting static content into a dynamic canvas.
Slides AI	[141]	Slides AI is an AI-powered solution that saves hours of work by automatically converting text into visually beautiful slides. It condenses the material on the slides into bite-sized chunks.
Synthesis	[142]	With synthesis, anyone can create professional-caliber, scalable, and cost-effective videos using AI.
Seo AI	[143]	SEO, using its unique algorithms and Google SERP monitoring, AI creates lengthy articles that are rich in SEO. They adhere to the values of creativity, audacity, openness, and ardor.
Github CoPilot	[144]	For the project being worked on, GitHub Copilot identifies the best code and helps to find the way whether unfamiliar with the language or having trouble with a particular section of the code. It might even function with other languages and aid with bug-tracking
Otter.ai	[145]	This is the meeting assistant who takes notes, creates summaries, records audio, and saves slides automatically. Otter records all of the talks, meetings, and interviews in real time so one can concentrate on the conversations.
Fliki AI	[146]	The greatest text-to-speech and text-to-video AI tool is Fliki AI. It uses AI audio and video techniques to alter the content so one can make engaging films for less money, time, and effort.
QuillBot	[147]	This AI-powered tool for paraphrasing creates alternative text by applying NLP techniques. The tool's purpose is to help users write better and more clearly while also saving time by automating the rewording process.

Table 4 summarizes common AI tools that have been found in pertinent, chosen literature. AI tools are automating jobs, increasing efficiency, and spurring creativity in a variety of fields, from creating imaginative text formats of photos with Dall-E 2 to producing excellent content with Textio [133, 134].

It is important to realize that there are many advantages to using AI tools: a) converting human insights into data and producing more objective and accurate decisions; b) managing tasks with greater volume and velocity that cannot be handled by human insights; c) offering the fastest generated results, giving users more results in less time; d) producing highly customized and personalized experiences and services; and, e) reducing errors for customers and organizations when using AI technologies.

4.4 AI SoU/Use Cases/ Applications

The narrative assessment found that AI has numerous significant applications in human life, with multiple use cases visible. Several notable ones are enumerated based on sectors/domains in the subsequent section:

a) Finance: AI has been created to assist in the early detection and prevention of fraudulent transactions [148]. Compared with conventional techniques like credit scores and consumer buy and sales histories, these instruments offer more accurate assessment methodologies. Due to their significant benefits, banks, lending institutions, and insurance firms almost all have internal AI systems [148]. Additionally, lending money and taking deposits from people, businesses, and organizations are regular activities for all entities in the finance sector [149].

b) Manufacturing industries: To efficiently use labor, equipment, and supplies, they integrate AI into inventory management, production planning, quality management, and logistics management [150]. Higher revenues and fewer losses are achieved through on-time delivery, breakdown prevention, and customer satisfaction. Unsupervised learning can be used in marketing systems to present advertisements, update social media feeds, and promote products, all falling under the subtheme of marketing [150, 151].

c) Healthcare: Applications where AI is appropriate include drug development and manufacturing, patient monitoring, robotic surgery, and historical record-keeping [152]. Through image analysis, doctors can determine the level of damage to human organs in accidents and distinguish between cases of benign or malignant cancer thanks to the most accurate illness predictions. Additionally, there are numerous uses for AI in the field of healthcare [153]. The most accurate methods for identifying any large databases of genetic information, medical imaging scans, and patient records are analyzed by ML algorithms to find patterns and generate precise predictions that enhance treatment results and diagnosis [153].

d) Retail: Retail establishments employ AI to manage their inventory in order to appropriately meet client requests all year long [154]. The program's online advice to customers regarding forgotten products or recommendations for related articles is an example of recent development. With AI, reviews and feedback data contribute to more sales and happier customers [154]. NLP can be utilized for chatbots, while computer vision with AI assistance can be used to monitor self-checkout kiosks [156].

e) Agriculture: Weather, moisture absorption, seed quality, and soil quality all affect food grain yield. Prior records of these provide the necessary information regarding appropriate crops to be planted on a specific plot of land [157]. Together,

DL for prediction, ML models, and image classification can provide the necessary backing for increased output that is free from disease. Robotic applications such as crop cutting, irrigation, and soil preparation can be completed more quickly than with human labor [158].

f) Automobiles and automation: Leading automakers have been experimenting with AI for a while now. Software applications are being used to automate every action a human can perform while operating a vehicle as precisely as feasible [159]. In the absence of a driver, the primary tasks being attempted by AI include avoiding obstructions, averting collisions and accidents, accurately interpreting signals, and adhering to traffic laws. To attain near perfection, electronic control units, sensors, cameras, GPUs, and cloud services are constantly being created and used for increased efficiency. A basic illustration would be a robotic vacuum cleaner, which uses AI to map homes and steer clear of objects like electrical cords, furniture, and pet toys [160]. Robots are being educated to interact with their surroundings predictably and dependably, so they are no longer limited to static circumstances. Robotics has been greatly impacted by the development of DL, even though getting huge datasets for training is still difficult [161].

g) Customer interaction: By responding to frequently asked questions, businesses can get better from client feedback [162]. Because of this, it is typical to encounter chatbots or other assistants who inquire, "May I help?" when one visits an online store. Through NLP, the chat boat can identify a predetermined set of questions and provide predetermined responses. The majority of questions are addressed throughout the day with a focus on customer satisfaction; unanswered questions are forwarded to a company executive [163]. There is an increase in business potential and significant savings in time and labor. Real estate and insurance industries frequently use this feature.

h) Electronic commerce: The following are some examples of how AI is used in this field [164]; Recommendation engines (a) rely on the habits and preferences of their users. AI-powered search engines can suggest more films, apparel, songs, and comparable home goods, among other things. b) Utilizing reviews: gathered reviews can assist businesses in enhancing their goods and services. AI can distinguish between fake and real reviews, and showing real reviews helps draw in more business. c) AI's usage of survey data: Information gathered from surveys helps companies better understand consumer behavior and raise anticipation for the release of new or enhanced products and market share. d) Online shopping: Recommendation engines are used by AI-powered e-commerce platforms to make product recommendations based on customers' browsing habits, past purchases, and activity. Furthermore, chatbots with NLP skills improve the shopping experience by helping customers with order monitoring, customer service, and product inquiries. f) Customized recommendations: To provide tailored recommendations, AI systems examine the preferences, actions, and previous exchanges of the user. AI-driven recommendation systems improve user experience by offering material catered to individual preferences, whether they are proposing movies on streaming platforms, products on e-commerce websites, or news articles on social media feeds [165].

i) Human resource: AI employment in human resources is not a recent development. The necessary skills for a certain employment post are scanned into submitted resumes [166]. Any position receives a large number of applications, therefore personally shortlisting candidates takes time and money [167]. Therefore, businesses employ automatic scanners that only submit applications that meet the majority of the necessary skill sets and requirements while rejecting those that are deemed inappropriate. In the early phases

of shortlisting, sample tests are also created and evaluated. AI also makes it feasible to evaluate employee performance.

j) Daily life: There is no denying that AI is improving many parts of human lives. It can improve learning results for kids, increase road safety, and have a good effect on a lot of other aspects of our daily lives. Prominent research organizations and industry behemoths like Apple, Facebook, Google, IBM, and Microsoft are heavily investing in AI research as the field's uses continue to spread [168]. Furthermore, Hollywood is using AI technologies to produce immersive virtual reality experiences. The significant impact of AI on our daily activities is examined in this section.

AI has permeated every area of our daily life, impacting every facet of our interactions and routines. AI technologies have permeated every aspect of our everyday lives, from virtual assistants on smartphones to personalized suggestions on streaming services. Here are a few significant areas where AI is affecting daily life: According to the review, AI is having an interesting impact on how we live our daily lives [168]. Among them are, for example: a) home appliances: AI-powered applications are integrated into star-rated freezers and automatic washing machines to provide comfortable operations with minimal human intervention, b) Health monitoring devices: A variety of businesses produce smartwatches that track various health factors, such as oxygen saturation, sleep patterns, and calories burned during exercise, c) internal housing arrangements: with AI tools, one can quickly experiment with different optimal configurations and handy locations of furniture, appliances, and other household items; d) email capabilities: emails have emerged as the most popular means of daily communication for both individuals and businesses.

One unique feature is the ability to move unknown or undesirable emails to the spam section. e) Virtual helpers: NLP and ML techniques are used by virtual assistants like as Siri, Alexa, and Google Assistant to comprehend customer inquiries and deliver pertinent answers [168]. These assistants make daily chores more convenient and effective by assisting users with a variety of tasks like answering inquiries, scheduling, controlling smart home devices, and setting reminders. Additionally Smart home appliances (f): AI-powered smart home appliances, like lighting controls, security cameras, and thermostats, learn user preferences and make automatic settings adjustments to maximize comfort, optimize security, and maximize energy economy. Voice-activated virtual assistants additionally augment the ease of use for controlling smart home appliances.

k) Navigation and transport: AI can be used to recognize geographical features in satellite photos, including flora, water bodies, and topography [169]. For navigational purposes, it can also be used for photos that show street views of various cities. This aids in the advancement of GPS technology, which gives users precise, timely, and comprehensive information while traveling. By automatically identifying the number of lanes and types of roads behind road barriers, the program makes use of CNN and Graph Neural Network to enhance the navigational experience. Transportation: Self-driving automobile reflexes and adaptability can be improved with the aid of computer vision and AI-powered robotics [170]. For instance, Tesla has dedicated years to developing autopilot technology for its vehicles. GPS technology has been incorporated into cars, revolutionizing transportation networks and offering important new information about travel trends. Autonomous vehicles are becoming more and more common because of the abundance of sensors installed in modern cars. Autonomous

vehicle technology has advanced significantly, with businesses such as Google and Tesla spearheading the progress. Nonetheless, there are still issues with humans depending on semi-autonomous systems and maintaining security. AI-powered navigation apps estimate arrival times, avoid traffic jams, and offer the best routes based on historical patterns, real-time traffic data, and user feedback [171]. Additionally, self-driving cars with AI algorithms installed can drive themselves across highways, lowering the chance of collisions and enhancing the effectiveness of transportation.

l) Social media: Four widely used social media sites are used by users for communication, information sharing, and other tasks that are made feasible by AI [172]. These are: a) Facebook: Facebook interprets conversations and automatically translates postings from many languages using AI, particularly Deep Text. b) Instagram: To determine which relevant images and videos should be shown in the user feed for an improved user experience, AI looks at the user account for previous likes and dislikes as well as accounts the user has followed. Based on the user's profile and previous interactions, AI also suggests relationships and posts that are pertinent. c) LinkedIn: Users exchange information about themselves, their accomplishments, noteworthy events, and recent advancements in the scientific and engineering domains [172]. Global relationships are formed, job information given is very helpful to recruiters and candidates alike, and data acquired is put to good use [174]. LinkedIn endeavors to enhance its ML methodologies to augment user and consumer happiness. d) Twitter: AI is employed here to convey users' viewpoints about various events that are discussed. However, upon closer inspection, offensive topics, false propaganda, and rumors of this kind are typically excluded, whereas tweets from state entities that serve the public interest are disseminated. Its user base is enormous.

m. Education: NLP can be used to teach language and other soft skills to learners through interactive chatbots. Over the past fifteen years, AI has advanced significantly in the field of education, finding applications in both K–12 and higher education [175]. Although human educators will always be essential to providing high-quality education, AI has the potential to improve individualized learning. Although it is unlikely that human teaching will entirely replace intelligent tutoring technologies and virtual reality apps, their use is predicted to increase in the years to come.

o) Entertainment: According to Choudhury et al. [176] and Frajberg [177] AI technologies are transforming the entertainment sector by facilitating personalized content recommendations, improving visual effects in films and video games, and producing immersive virtual reality experiences. AI algorithms examine user behavior and preferences to make personalized recommendations for films, TV series, music, and video games [178].

n) Security: To extract data, recognize photos, detect dangers, and assist with AI-powered governance, one can utilize DL, NLP, and NER [179, 180].

In general, AI has permeated every aspect of our everyday lives, providing tailored experiences, increasing convenience, and revolutionizing several industries. AI technologies are predicted to have a greater influence on daily life as they develop, bringing in a new era of intelligent automation and customized services.

4.5 AI Empirical Development Ultimate Guide

The study offers the following empirical guidance for the development and implantation of AI technology by any AI-interested parties. The steps and procedures involved in this guidance are summarized in Figure 1.

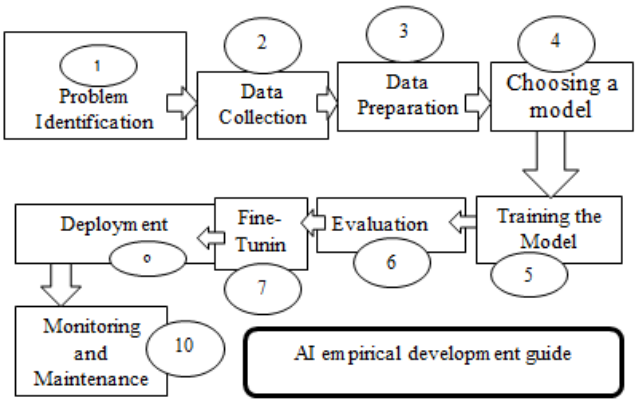

Figure 1. AI Empirical development and implementation ultimate guide.

a) Definition of the problem space: Clearly state the issue that one wishes AI to address. Finding an appropriate AI solution requires first understanding the problem; b) Collection the data that the AI application will use for learning. Using pre-existing datasets or gathering new data may be necessary for this. The AI model's success is highly dependent on the quantity and quality of the data. c) Data preparation: Clean and arrange the data. To do this, make necessary corrections, eliminate duplicates, and format the data consistently. d) Model selection: this entails picking the best AI or ML model for the situation and preparing data results in more accurate AI models. This could use ML algorithms, neural networks for DL, or customized models for particular tasks. f) Model training: Make the model capable of generating predictions or judgments based on the data. This entails providing the model with the data and modifying its parameters until the model operates as intended. f) Evaluation: See how well the AI model works by running it on fresh, untested data. This contributes to the accuracy and dependability of the model. g) Fine-tuning: Adapt the model to the outcomes of the evaluation. This could entail attempting a different model entirely, modifying parameters, or retraining it with more data. h) Deployment: After the AI model is complete; incorporate it into functional systems or applications. This can include cyber security, app creation, voice assistants, and image recognition software. i) Monitoring and maintenance. Monitor the functioning of the AI system and implement any required modifications or enhancements. As fresh data is received, AI models may require retraining to maintain their effectiveness.

5. Conclusion and Future Work

With so many benefits, the application of AI in various industries, nations, and continents has grown in importance in recent years. The technological roadmap aspects related to the development and execution of AI projects and systems were highlighted in this study. In addition to imagining an empirical guide to AI development and implementation for use by AI stakeholders, these roadmap components include AI development and implementation frameworks, AI development techniques/platforms, existing AI tools, and AI SoU/use cases/applications. We found that most studies indicate a limited number of these elements with specifics and fragmentation in a particular industry. In addition, the study revealed that AI can only be proven beneficial if its facets related to its technical development and implementation (frameworks, techniques, tools, SoU/application) are systematically known and understood by the parties involved. AI stakeholders at all levels can methodically comprehend the entire roadmap for the AI application development continuum as well as the related technological possibilities with the help of this narrative review. To greatly simplify the job of developers, practitioners, and researchers in AI, the review examined a range of AI development frameworks, AI approaches, and AI tools, as well as SoU for AI from the existing scholarly works. For the interest of the future works of this review, future endeavors can look into how each of the AI roadmap elements identified can be applied in practice in a particular domain. The survey of existing literature opens new avenues for research in this domain and its potential for development like any investigation focusing on evaluating the proposed empirical guide in this paper will be paramount to the field.

CONTRIBUTIONS OF CO-AUTHORS

Matendo Didas	Conceived the idea and wrote the paper
Shuubi Alphonce Mutajwaa	Analyzed results and Revised the Paper

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