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## AI-Driven Software Requirements Elicitation: A Novel Approach

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**Abstract:** Artificial Intelligence (AI) in software engineering automates tasks like code generation, testing, and bug detection, improving efficiency and quality. It also enables predictive analytics for project management, personalization, and cybersecurity, enhancing software development and maintenance. The proposed research study aims to investigate the role of AI in software requirement elicitation, with the primary objectives being to provide a clear understanding of its impact and the scope of its application in this domain. In this research study, we undertake a comprehensive examination of prior research on AI-driven approaches for software requirements. The research analysis delves into the existing body of work to identify key strengths, weaknesses, and emerging trends in this field. Furthermore, we scrutinize this body of literature with a keen eye to discern the gaps and challenges that persist, hindering the advancement of AI-driven techniques in software requirement elicitation. These identified gaps and challenges serve as a critical backdrop against which our novel approach is positioned, with the primary aim of addressing and ameliorating the limitations of current practices in this domain. Moreover, as part of our research, we will meticulously identify a diverse set of AI techniques that possess the capacity to enhance and improve the software requirement elicitation process.

**Keywords:** *Artificial Intelligence, Software development, Software Engineering, Requirement Elicitation Techniques,*

### 1. INTRODUCTION

Software engineering encompasses a wide range of duties and activities across the software development lifecycle. These consist of requirement analysis, system design, detailed design, coding, testing, deployment, maintenance, project management, quality assurance, configuration management, documentation, risk management, security, user training and support, and software lifecycle planning. Creating, implementing, and overseeing dependable, efficient, and user-friendly software solutions is the main objective of these tasks. Software requirement elicitation is a fundamental phase in the software development process that establishes the framework for the entire undertaking. In this first step, stakeholder requirements and expectations are gathered, understood, and documented. The software solution is developed using these steps as guidance. To acquire and record the needs and expectations of stakeholders, including clients and end users, software requirement elicitation traditionally entails several tasks, including meetings and conversations. For this procedure to comprehend the software's functional and non-functional needs, a lot of interviews, surveys, questionnaires, and document analysis are used. Formal requirement documents, use cases, or specifications are created from the gathered data, and these documents act as a basis for the ensuing stages of software development. This conventional method can be laborious and can produce unclear or insufficient requirements, which can cause problems in the development process.

Artificial intelligence technologies like machine learning and natural language processing are utilized in software requirement elicitation processes using AI-driven techniques, which automate and improve the process. By evaluating data and projecting future requirements, these methods can increase requirement collection accuracy, thoroughness, and responsiveness. This study investigates how AI can be used to streamline the process of gathering software requirements.

The limits of conventional software requirement elicitation techniques constitute the research problem. Software development may face difficulties as a result of these methodologies' time commitment, error-proneness, and potential to overlook changing needs. To overcome these problems, a new strategy that makes use of AI is required. This strategy should improve the effectiveness, precision, and flexibility of the requirement elicitation process, ultimately guaranteeing that software is more in line with the changing needs of stakeholders and users [9].

The primary objectives of our research are twofold. First, to comprehensively explore and evaluate the current landscape of software requirement elicitation, identifying its limitations and challenges. Second, to develop and propose a novel AI-driven approach for software requirement elicitation that not only addresses these limitations but also enhances the overall efficiency, accuracy, and responsiveness of the process. The rest of the paper is structured as - Section 2 reviews relevant literature, Section 3 outlines the research methodology, Section 4 analyses critical aspects, and Section 5 concludes the study while suggesting future research directions.

## 2. LITERATURE REVIEW

In the realm of software requirement elicitation, the literature review reveals a diverse range of studies and approaches:

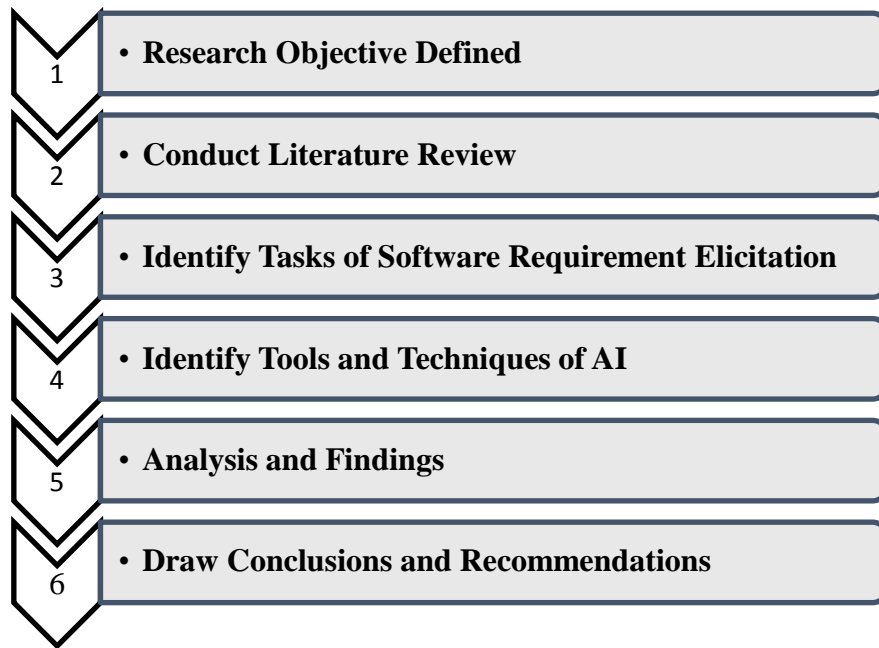
- **Eliciting Significance:** Sethia and Anitha [14] highlight the well-established significance of effective software requirement elicitation, with a focus on its impact on project performance. They seek to explore broader issues within requirements elicitation, introducing a novel framework to mitigate performance risks.
- **Filling the Gap:** Michael and Kyo [10] distinguish themselves by centering on requirements elicitation, often overshadowed in requirements engineering. They introduce an elicitation methodology to comprehensively address associated challenges.
- **Human-Centered Approach:** Khlood et al. [7] showcase a human-centered requirements engineering framework and tool within an AI system context. This case study reveals previously overlooked human-centered aspects and the evolving nature of requirements in the health application.
- **User Needs Understanding:** Naiara et al. [13] emphasize the intricate process of understanding user needs through requirements elicitation, presenting various techniques, and introducing a model to assess team involvement and technique usage.
- **Evolving Challenges:** Hafsa et al. [6] address the evolving challenges in software requirements engineering, particularly in the context of mobile app development. Their systematic review assesses various elicitation techniques, offering insights into mobile app development.
- **Principal Techniques:** Researchers Mona and Archana [11] delve into principal elicitation techniques and introduce a five-facet model for technique selection, which considers various project and organizational characteristics.
- **AI Integration:** Konstantinos and Julia [9] examine the role of AI in improving Requirements Elicitation and Analysis through a systematic literature review, highlighting AI methods and tools.
- **Utilization and Impact:** Pacheco et al. [1] analyze the utilization and impact of established software requirements elicitation techniques, providing insights into the efficacy of these techniques considering various project and stakeholder factors.

- **Key Cornerstone:** Shadab et al. [15] stress the essential role of effective requirement elicitation in successful application development, emphasizing its significance as a cornerstone for aligning systems with stakeholder expectations.
- **Systematic Elicitation:** Muhammad's [12] focus is on Systematic Requirements Elicitation within the Software Development Life Cycle, assessing existing approaches and introducing a novel requirement-gathering methodology.
- **Pivotal Role:** Gopichand [5] highlights the pivotal role of requirements elicitation and analysis in the software development life cycle, ensuring customer needs are met.
- **ML and NLP Integration:** Cheliger [2] investigates the application of machine learning (ML) and natural language processing (NLP) in requirements elicitation, identifying ML-based tasks and categorizing techniques.
- **Project Scope Management:** Denys [3] emphasizes the importance of project Scope Management, specifically in defining project scope through elicitation techniques.
- **Business Analysis Impact:** Denys and Inna [4] express the vital role of elicitation in business analysis and requirement engineering, impacting project success.
- **Enhancing Communication:** Tabbassum [16] underscores the significance of effective requirement elicitation, aiming to bridge the gap in communication between analysts and users in real-time applications.
- **AI in Requirements Engineering:** Khlood et al. [8] explore the relatively unexplored field of industry practices in Requirements Engineering (RE) for AI, highlighting the integration of human-centered aspects.

These studies collectively contribute to the evolving landscape of software requirement elicitation, emphasizing its importance, challenges, and the need for effective techniques and methodologies.

### 3. RESEARCH METHODOLOGY

The process of gathering software requirements is a crucial step in the development of any project in the dynamic field of software engineering. The entire success of software development projects is strongly influenced by the effectiveness and precision of this phase. With artificial intelligence (AI) emerging as a game-changing technology, there is a growing chance to improve and expedite the process of eliciting software requirements. The goal of this study methodology is to offer a methodical and organized way to look into how AI tools and approaches might be integrated into the process of gathering software requirements. The main goal of the study is to determine whether using AI in this crucial software engineering phase may increase its correctness and efficiency. A thorough literature review, the identification of important requirement elicitation tasks, the categorization of pertinent AI techniques and tools, the mapping of AI methods to particular tasks, data collection and experimentation, and a thorough analysis of findings are just a few of the interconnected steps that make up this methodology. By using this methodology, we hope to improve our knowledge of how artificial intelligence might improve the elicitation of software requirements and offer useful information to researchers and practitioners in the field. The research methodology is highlighted in Fig.1.

**Fig. 1.** Research Methodology

Effective software requirement elicitation techniques are fundamental to ensuring that software systems align with stakeholder needs. Various methods for requirement elicitation are listed in Table 1.

**Table 1.** Requirement Elicitation Techniques

Sr No.	Elicitation Techniques	Description
1.	Interviews	Face-to-face conversations with stakeholders to learn about their expectations and software requirements.
2.	Workshops	Group brainstorming and requirement prioritization sessions with stakeholders.
3.	Visual Prototypes	Making visual prototypes of the software to get input on its features and design is known as prototyping.
4.	User Stories	An agile method for distilling user needs into succinct, well-organized narratives.
5.	Use Cases	Recording certain scenarios and interactions with the system.
6.	Feedback and Review Sessions	Working with stakeholders to refine requirements through iterative sharing and discussion.
7.	Document analysis	Document analysis is the process of taking needs out of reports and business documents that already exist.
8.	Context diagram	Visual depictions of system interactions and interfaces with outside elements are called context diagrams.
9.	Prioritizing requirements	Arranging them according to their significance and worth to the business.
10.	Change Requests	As the project moves forward, managing and adapting to changing requirements is necessary.

A thorough summary of AI methods that are useful for eliciting software requirements is provided in Table 2. These methods offer novel approaches to collecting, comprehending, and managing software project requirements. They constitute a ground-breaking fusion of artificial intelligence and software engineering. AI's uses in software development are becoming more and more common as the field develops, with the potential to improve and expedite the elicitation process through the use of machine learning, natural language processing, and other cutting-edge technologies. With its insights

on how AI may be used to optimize the critical early stages of software development, this table is an invaluable tool for software professionals.

Table 2. Requirement Elicitation Techniques

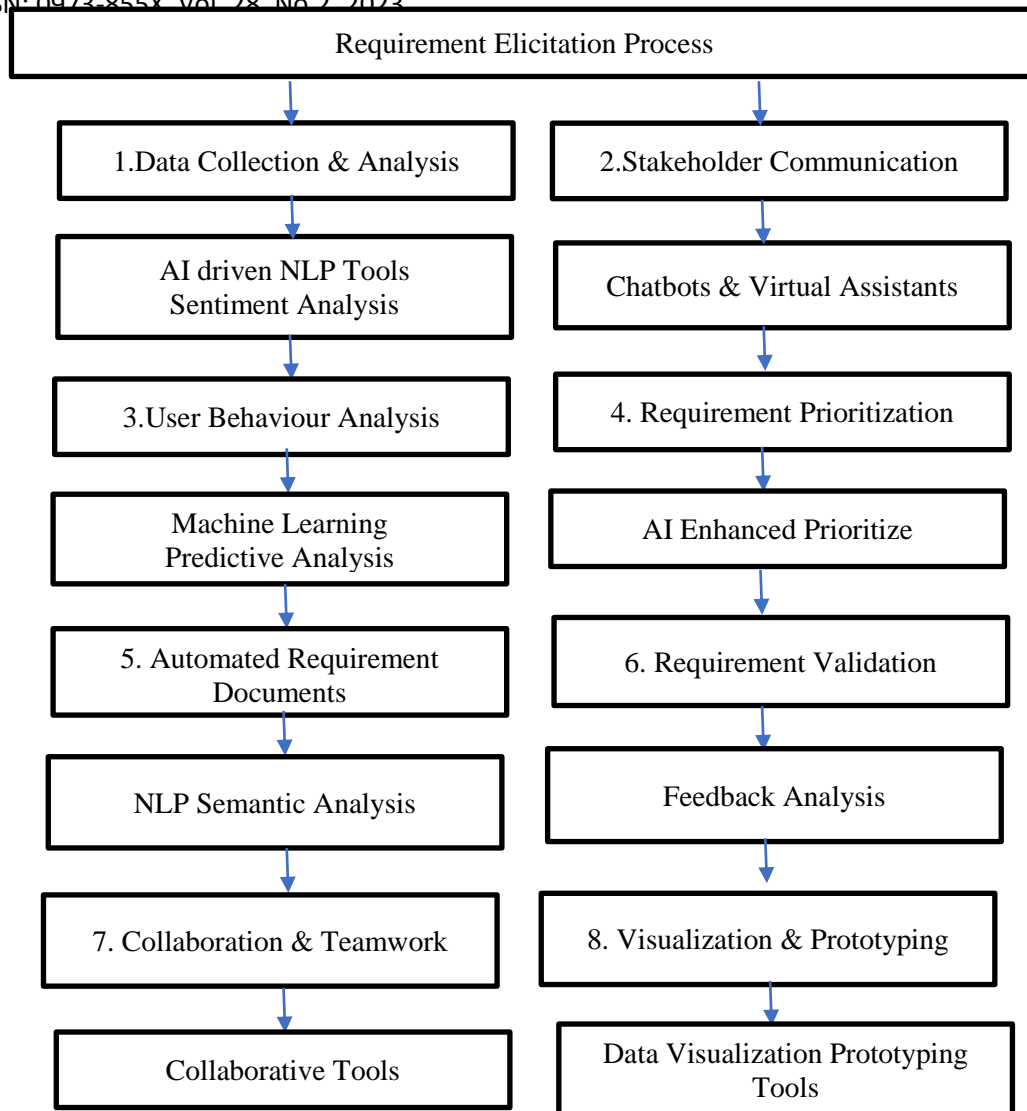
Sr No.	AI Techniques
1.	Natural Language Processing (NLP), Machine Learning, and Knowledge-Based Systems
2.	Chatbots and Virtual Assistants:
3.	Sentiment Analysis
4.	Clustering
5.	Recommendation Systems
6.	Automated Documentation Generator
7.	Voice and Speech Recognition
8.	User Behaviour Analytics
9.	Predictive Analytics
10.	Collaborative Filtering
11.	Topic Modelling
12.	Data Visualization
13.	AI-Enhanced Prioritization Tool

#### 4. ANALYSIS & FINDINGS

In the analysis and findings section that follows, we will take a close look at two critical areas of software requirement elicitation. The first aspect of this analysis is the detailed mapping between the software requirement elicitation method and AI tools and techniques. It explains how artificial intelligence and requirement collecting work hand in hand and how AI-powered solutions may drastically improve the efficacy and efficiency of this crucial stage. Parallel to this mapping, we explore another crucial aspect, which is the evaluation of conventional elicitation techniques in comparison to AI-powered alternatives. This thorough comparative analysis provides a nuanced view of the future of software requirement elicitation techniques by illuminating the benefits, drawbacks, and transformational potential of AI-based techniques. When taken as a whole, these studies and conclusions aim to offer a comprehensive picture of the revolutionary effects of artificial intelligence on the field of software development and how it will influence requirements engineering going forward. In the "Analysis and Findings" section, we present:

##### 4.1 Mapping of AI Tools and Techniques with Software Requirement Elicitation.

In Figure 2, we provide a visual representation of the intricate alignment between AI tools and approaches and the crucial software requirement elicitation step. This picture offers a detailed explanation of how requirements collecting and artificial intelligence function together. By connecting AI capabilities to every phase of software requirement elicitation, this image acts as a visual aid to help understand the mutually beneficial relationship between AI-driven solutions and the challenges of eliciting and specifying software requirements. This visual representation can help software developers and project stakeholders understand how artificial intelligence (AI) can accelerate and enhance the crucial early phases of software development.



**Fig. 2.** Mapping of AI Tools and Techniques with Software Requirement Elicitation

In the subsequent section, we provide an in-depth exploration of the graphical mapping that illustrates how AI tools and techniques are strategically integrated into critical tasks within the software requirement elicitation process. This visual representation offers a comprehensive understanding of the symbiotic relationship between AI and requirement gathering.

- **Data Collection and Analysis**

**Natural Language Processing (NLP):** AI-powered NLP systems can sift through enormous volumes of textual data, including emails, user manuals, and comments from users, to extract pertinent information and spot new needs.

**Sentiment Analysis:** Artificial intelligence (AI) can evaluate the tone of user comments to better understand user preferences and problems, which helps guide requirement collection.

- **Stakeholder Communication:**

**Virtual assistants and chatbots:** Chatbots can interact with stakeholders, providing answers to their inquiries and gathering basic data about their needs.

Voice and Speech Recognition: Artificial intelligence (AI)-powered speech recognition systems can record stakeholders' spoken input, guaranteeing that their specifications are accurately recorded.

- User Behaviour Analysis:

Machine Learning Algorithms: AI can detect implicit requirements based on how users interact with current software by analyzing user behaviour data to find patterns and trends.

Predictive analytics: By examining past data and projecting shifts in user behaviour, AI can foresee future requirements.

- Requirement Prioritization:

AI-Enhanced Prioritization: AI can prioritize requirements more efficiently by taking into account several aspects, including business impact, risk, and feasibility. This ensures that the most important demands are taken care of first.

- Automated Requirement Documentation:

NLP and Semantic Analysis: AI can create requirement papers by organizing and condensing data from a variety of sources, enhancing the documentation's coherence and clarity.

- Requirement Validation and Feedback Incorporation:

Feedback Analysis: As new information becomes available, AI systems may filter and analyze stakeholder feedback to assist in validating and revising requirements in real time.

- Collaboration and Teamwork:

Collaborative Tools: Teams can collaborate more easily and share ideas and inputs during requirement elicitation with the use of AI-enhanced collaboration platforms.

- Visualization and Prototyping:

Data Visualization: AI-driven solutions for data visualization can aid in simplifying complex data so that requirements are easier to identify and convey.

Prototyping Tools: To help stakeholders better grasp the intended software, several prototyping tools employ artificial intelligence (AI) to create interactive prototypes.

#### 4.2 Comparison of Traditional Elicitation with AI-Based Approach.

The process of gathering requirements is changing significantly in the context of software development nowadays. AI-based strategies that make use of cutting-edge technology like machine learning and natural language processing are increasingly competing with traditional methods that depend on human contact and manual processes. The comparative study of these two methods' advantages and disadvantages is shown in Table 3. To give project managers and stakeholders insight into the most efficient requirement elicitation technique, it examines their approaches, efficacy, accuracy, and flexibility.



Table 3. Comparative Analysis of AI-based &amp; Traditional Requirement Elicitation Process

Sr. No.	Comparison Criteria	AI-Based	Traditional
1.	Data Processing	AI-based techniques automate data processing through the use of machine learning and natural language processing algorithms. They are more adept at handling massive amounts of data consistently and efficiently.	Conventional techniques focus on the manual processing of vocal and textual information. The abilities of human analysts are the only ones that can analyze data.
2.	Data Sources	AI techniques can extract needs from a broader variety of unstructured data, such as emails, documents, social media, and material created by users. They can conclude from a variety of sources, providing a more complete picture of the needs.	Conventional techniques involve conducting workshops, surveys, and interviews to get needs. Data sources are frequently restricted to conversations with stakeholders directly.
3.	Data Accuracy	AI-based approaches have the potential to offer unbiased, consistent analysis. They are highly accurate in spotting trends, patterns, and abnormalities.	The skill of the human analysts determines how accurate traditional methods are. Interpretation and subjectivity can lead to mistakes.
4.	Speed and Efficiency	Large datasets can be processed and analysed quickly using AI techniques. They drastically cut down on the amount of time required for analysis by automating requirement extraction.	These techniques are frequently labour- and time-intensive. The transcription, processing, and documentation of data may necessitate a substantial amount of work.
5.	Adaptability	To meet the requirements of a given project, AI-based techniques may need to be customized and trained. Their ability to handle complicated or unusual requirements could be limited.	Conventional approaches can be modified to accommodate various project scenarios and stakeholder inclinations. They provide flexibility in response to needs that change.
6.	Cost	Although AI-based approaches could necessitate a one-time investment in technology and knowledge, they might be economical when used to repeated or large-scale operations.	Conventional approaches can be more costly since they require more time and resources for labour-intensive tasks like workshops and interviews, but they may have cheaper initial technology expenses.
7.	Human Involvement	Although AI-based approaches can eliminate the need for direct human interaction, they cannot have the same contextual awareness or human touch.	Conventional approaches entail face-to-face communication and cultivating connections with relevant parties. Communication abilities and human knowledge are critical.

In summary, the technological comparison shows that whereas AI-based approaches take advantage of automated data processing, scalability, and consistency, traditional approaches rely on manual processes and human experience. The precise technical requirements of the project, the resources at hand, and the requirement for direct stakeholder engagement all influence which of these approaches is best. Combining the two approaches can often produce the best outcomes by leveraging each one's advantages.

## 5 CONCLUSION & FUTURE ENHANCEMENT

A new paradigm for acquiring, comprehending, and managing software requirements is provided by AI-driven methodologies. They leverage machine learning, natural language processing, and other cutting-edge technologies to present a novel synthesis of software engineering and artificial intelligence. AI considerably increases the dependability of needs collected by bringing previously unheard-of levels of precision, comprehensiveness, and responsiveness to requirement collecting. Furthermore, the way we approach software development is fundamentally altering as a result of AI's capacity to anticipate and adjust to changing requirements. On the other hand, while traditional requirement elicitation techniques have their role and importance, they are frequently laborious, prone to mistakes, and possibly confusing. These restrictions may make it more difficult to design software, particularly when handling complicated and ever-changing project needs. Nonetheless, the particular circumstances of a project should determine whether to use traditional or AI-based approaches. Artificial Intelligence (AI) is especially useful for large-scale, repetitive, or data-intensive projects since it is excellent at handling enormous datasets, automating operations, and simplifying processes. On the other hand, traditional approaches are useful in circumstances where face-to-face communication, comprehension of the context, and involvement of stakeholders personally are critical. Numerous directions for further research and development in the area of AI-driven software requirement elicitation are made possible by this study:

- **AI Model Refinement:** To increase accuracy and adaptability, more research can be done on improving AI models. Potential areas of expansion include customization and fine-tuning for certain businesses and disciplines.
- **User-Centric AI:** It's interesting to think of using AI to collect real-time user feedback and needs. It will be beneficial to have AI systems that recognize and accommodate the preferences of different stakeholders.
- **Hybrid Approaches:** Investigating how conventional and AI-driven techniques might complement one another to optimize the advantages of each strategy in various project contexts.
- **AI-Enhanced Collaboration:** Creating AI-powered solutions to help stakeholders cooperate and work together during the demand elicitation process.
- **Education and Training:** Ensuring that software professionals are capable of incorporating AI into their projects and are prepared to properly harness the power of AI.
- **Security and Compliance:** This research aims to make sure that privacy and data security laws are followed via AI-driven demand elicitation.

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