Identifying and Comparing Emerging Technical Trends Across Platforms Using Keyword Extraction

A Cross-Platform Analysis of Robotics and AI Discussions on GitHub, Reddit, Stack Overflow, and arXiv

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Abstract

This research systematically identifies and compares emerging technical trends in robotics and artificial intelligence (AI) by analyzing discussions across four major online platforms: GitHub, Reddit, Stack Overflow, and arXiv. Using automated keyword extraction techniques, the study uncovers both shared and unique topics that shape the discourse in these fields. The findings reveal a convergence around large language models, human-robot interaction, and generative AI, while also highlighting platform-specific focuses such as implementation details on GitHub and Stack Overflow, social aspects on Reddit, and methodological advancements on arXiv. This cross-platform analysis provides a comprehensive view of current trends and opportunities for interdisciplinary collaboration in robotics and AI.

1 Introduction

The purpose of this research is to systematically identify and compare emerging technical trends in the fields of robotics and artificial intelligence (AI) by analyzing discussions and content across multiple online platforms. By leveraging automated keyword extraction techniques, this study aims to uncover both shared and unique topics that are shaping the development and discourse of robotics and AI in recent years.

The scope of the project encompasses four major platforms: GitHub, Reddit, Stack Overflow, and arXiv—each representing different facets of the robotics and AI ecosystem, including open-source development, community discussions, technical problem-solving, and academic research. Through a cross-platform analysis, the research seeks to provide a comprehensive overview of current trends, highlight platform-specific focuses, and identify opportunities for interdisciplinary collaboration. This approach sets the foundation for understanding how technical innovations and community interests evolve and intersect across diverse online environments.

2 Motivation

The rapid advancement of robotics and artificial intelligence (AI) is fundamentally transforming industries, economies, and daily life. As these technologies become increasingly integrated into critical domains such as healthcare, transportation, manufacturing, and education, understanding their development trajectories is essential for researchers, practitioners, and policymakers alike.

Identifying and comparing emerging technical trends across multiple platforms is particularly important because each platform captures unique perspectives and contributions—from cutting-edge academic research to practical implementation and community-driven innovation. By systematically analyzing discussions and content from diverse sources, we can gain a holistic view of how robotics and AI are evolving, which technologies are gaining traction, and where future opportunities and challenges may lie.

This research not only informs the direction of future studies and technological development but also helps stakeholders anticipate societal impacts, address ethical considerations, and foster interdisciplinary collaboration. Ultimately, a comprehensive understanding of emerging trends empowers the community to guide the responsible and impactful advancement of robotics and AI.

3 Background

The fields of robotics and artificial intelligence (AI) have experienced rapid growth and transformation over the past decade, driven by advances in machine learning, computer vision, natural language processing, and autonomous systems. Robotics integrates mechanical engineering, electronics, and computer science to design and build machines capable of performing tasks autonomously or semi-autonomously. AI, on the other hand, focuses on creating systems that can simulate human intelligence, including reasoning, learning, perception, and decision-making.

Recent breakthroughs in deep learning and large language models (LLMs) have significantly expanded the capabilities of both robotics and AI. These technologies enable robots to interpret complex sensory data, interact more naturally with humans, and adapt to dynamic environments. Applications now span a wide range of domains, from industrial automation and autonomous vehicles to healthcare, education, and creative arts.

The dissemination and discussion of new ideas, tools, and research findings in robotics and AI occur across a variety of online platforms. GitHub serves as a hub for open-source software development, facilitating collaboration and code sharing among practitioners. Reddit provides a space for community-driven discussions, where users share news, opinions, and experiences. Stack Overflow is a question-and-answer site focused on technical problem-solving, while arXiv is a preprint repository for academic research papers.

Understanding how technical trends emerge and propagate across these platforms is crucial for capturing the multifaceted evolution of robotics and AI. Prior studies have examined individual platforms or focused on specific technologies, but comprehensive cross-platform analyses remain limited. Automated keyword extraction methods, such as YAKE, offer scalable approaches to identifying salient topics and trends within large, heterogeneous datasets.

This research builds on existing work in trend analysis, text mining, and scientometrics, aiming to bridge gaps between academic research, practical development, and community discourse. By systematically comparing content from multiple platforms, the study seeks to provide a holistic view of the current landscape and emerging directions in robotics and AI.

4 Research Method

4.1 Research Question

The primary research question is: **Identifying and Comparing Emerging Technical Trends Across Platforms Using Keyword Extraction: A Cross-Platform Analysis of Robotics and AI Discussions on GitHub, Reddit, Stack Overflow, and arXiv**.

4.2 Data Collection

To comprehensively identify and compare emerging technical trends in robotics and AI, we collected data from four major online sources: GitHub, Reddit, Stack Overflow, and arXiv. The collection process was automated using Python scripts and relevant APIs or libraries for each platform.

GitHub: We used the PyGithub library to programmatically search for repositories created after 2019-12-31. The search queries combined keywords such as "robot", "robotic", "generative ai", "emotional intelligence", and "human-robot" in the repository name, description, or README. For each repository, we downloaded the README file, removed HTML tags and markdown links using BeautifulSoup and regular expressions, and filtered out common stop words and personal names. This ensured that only meaningful technical content was retained for analysis.

Reddit: Using the PRAW API, we searched all subreddits for posts containing the same set of keywords. For each post, we concatenated the title and selftext, cleaned the text to remove contractions and irrelevant content, and filtered out duplicates using unique post IDs. This approach captured a wide range of user discussions and opinions related to robotics and AI.

Stack Overflow: We queried the Stack Exchange API for questions posted after 2019-12-31 that contained "robot" or "robotic" in the title, body, or tags. We extracted the question titles and bodies, decoded HTML entities, and included only those posts that were relevant based on tags or content. This allowed us to focus on technical questions and solutions discussed by the developer community.

arXiv: We used the arXiv API to retrieve abstracts of recent papers matching the same set of keywords. Papers were deduplicated using unique paper IDs. This provided insight into the latest research trends and terminology in the academic community.

For all platforms, we applied consistent data cleaning steps, including removing HTML tags, markdown links, URLs, and a custom set of stop words. The number of keywords extracted and the n-gram size were parameterized to ensure reproducibility and comparability across datasets.

4.3 Data Analysis

We applied the YAKE (Yet Another Keyword Extractor) algorithm to each cleaned dataset to extract the most relevant technical keywords. YAKE is an unsupervised, statistical keyword extraction method that considers the frequency, position, and context of terms within the text. For each document (e.g., README, Reddit post, Stack Overflow question, or arXiv abstract), we extracted the top 20 keywords, allowing for unigrams, bigrams, and trigrams (n-gram size up to 3).
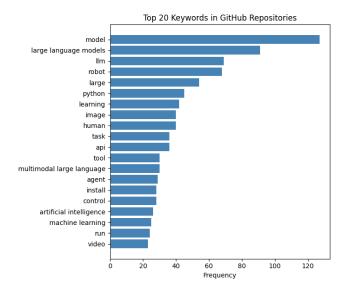

Figure 1: Top20 Keywords from GitHub Repositories

The extracted keywords from each platform were aggregated using Python's `Counter` class to compute their frequencies. We then identified the top 100 keywords per platform and performed set operations to find common and unique terms across platforms. Additionally, we visualized the results using word clouds and bar charts to highlight the most prominent trends.

To ensure the robustness of our findings, we compared keyword distributions, analyzed overlaps and differences, and interpreted the significance of recurring terms. This multi-platform, multi-method approach enabled a comprehensive and reproducible analysis of emerging technical trends in robotics and AI.

5 Findings

5.1 Emerging Trends

5.1.1 **GitHub**. Top20 keywords extracted from relevant GitHub repositories include: model, large language model, llm, large, python, learning, etc. As shown in Figure 1, the most frequent keywords reflect a strong focus on large language models (LLMs) and machine learning frameworks, indicating a trend towards advanced AI applications in robotics.

5.1.2 **Reddit**. Top20 keywords extracted from relevant Reddit posts include: robot, human, video, art, game, emotional intelligence etc. As shown in Figure 2, the focus on human-robot interaction, emotional intelligence, and creative applications suggests a growing interest in the social and ethical dimensions of robotics and AI.

5.1.3 **Stack Overflow**. Top20 keywords extracted from relevant Stack Overflow questions include: robot, robot framework, test, run, python, error, etc. As shown in Figure 3, the emphasis on testing frameworks and error handling indicates a practical focus on developing robust robotic systems, with a strong community engagement in troubleshooting and problem-solving.
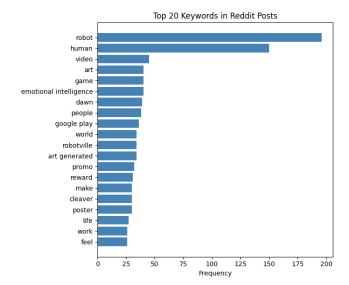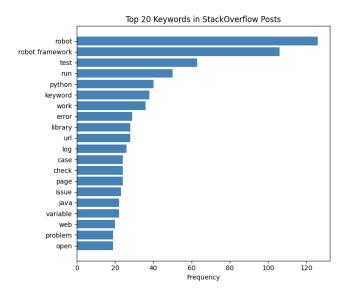
Figure 2: Top20 Keywords from Reddit Posts

Figure 4: Top20 Keywords from arXiv Abstracts

Figure 3: Top20 Keywords from Stack Overflow Questions

5.1.4 **arXiv**. Top20 keywords extracted from relevant arXiv abstracts include: model, task, method, llm, policy, autonomous driving, etc. As shown in Figure 4, the academic focus on methodologies, tasks, and autonomous systems highlights the ongoing research efforts to advance AI capabilities in robotics, particularly in autonomous driving and policy learning.

5.2 Cross-Platform Comparison

For the cross-platform comparison, we aggregated the top 100 keywords from each platform and performed set operations to identify common and unique terms.
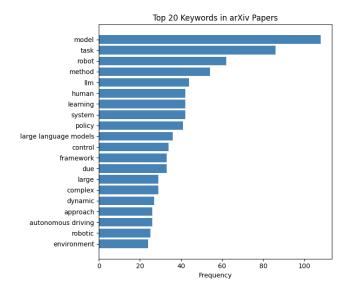
(1) **Common Keywords across all 4 platforms:** The intersection of keywords from GitHub, Reddit, Stack Overflow, and arXiv is shown in Table 1.

Table 1: Common Keywords across all Platforms

key	robot	work

(2) **arXiv ∩ GitHub:** The intersection of keywords from arXiv and GitHub are shown in Table 2.

Table 2: Common Keywords in arXiv and GitHub (33)

agent	artificial intelligence	based
control	dataset	deep
design	environment	framework
generative	graph	human
image	key	language
large	large language models	learning
llm	method	model
performance	policy	reinforcement learning
research	robot	robotics
task	tool	training
video	visual	work

(3) **arXiv ∩ Reddit:** The intersection of keywords from arXiv and Reddit are shown in Table 3.

(4) **arXiv ∩ Stack Overflow:** The intersection of keywords from arXiv and Stack Overflow are shown in Table 4.

(5) **Unique words in arXiv:** The unique keywords found only in arXiv abstracts are shown in Table 5.

Table 3: Common Keywords in arXiv and Reddit (15)

artificial intelligence	generative	goal
high	human	key
language	model	reward
robot	robotic	robotics
tool	video	work

Table 4: Common Keywords in arXiv and Stack Overflow (12)

action	based	field
framework	image	key
method	problem	process
robot	set	work

Table 5: Unique Keywords in arXiv (58)

accuracy	aerial	algorithm
approach	autonomous driving	autonomous vehicles
benchmark	complex	crucial
diffusion	diverse	domain
driving	due	dynamic
flow	force	genai
introduce	lack	manipulation
module	motion	network
neural	object	offer
paper presents	planning	point
pose	present	propose
rapid	real-time	real-world
recent	recent advances	result
robust	safe	safety
sample	scenario	scene
sensor	shown	space
state	study	system
traffic	trained	trajectory
vehicle	vision-language models	vla
vlms		

5.3 Keyword Analysis

The results above revealed several key insights:

(1) **Common Themes:** Across all platforms, there is a strong emphasis on large language models (LLMs), human-robot interaction, and practical applications in robotics. This suggests a convergence of interests in both academic research and community-driven development.

(2) **Platform-Specific Focus:** GitHub and Stack Overflow are more focused on technical implementation and problem-solving, while Reddit emphasizes social aspects and creative applications. arXiv provides a theoretical foundation with a focus on methodologies and research advancements.

(3) **Emerging Trends:** The analysis highlights the growing importance of generative AI, emotional intelligence, and autonomous systems in robotics. These trends reflect broader societal interests in ethical AI, human-robot collaboration, and advanced machine learning techniques.

(4) **Unique Contributions:** arXiv abstracts contain unique keywords related to advanced methodologies and specific applications in autonomous driving and robotics, indicating ongoing research efforts to push the boundaries of AI capabilities.

5.4 Visualization

To visualize the keyword distributions, we generated word clouds for each platform using the top 100 keywords. The word clouds highlight the most frequently occurring terms, with larger words indicating higher frequency. This provides an intuitive overview of the dominant themes and trends across platforms. See **Appendix** for the word clouds.

6 Discussion

The findings from this cross-platform analysis reveal both convergence and divergence in the way robotics and AI are discussed and developed across different online communities. The strong presence of keywords related to large language models (LLMs), human-robot interaction, and generative AI across all platforms suggests that these topics are at the forefront of both academic research and practical development. This convergence indicates a shared recognition of the importance of advanced AI techniques and their integration into robotics.

However, the unique keywords and themes identified on each platform highlight the distinct roles these communities play. For example, GitHub and Stack Overflow are more focused on implementation details, frameworks, and troubleshooting, reflecting their utility for practitioners and developers. In contrast, Reddit discussions emphasize social, ethical, and creative aspects, indicating a broader public engagement with the implications of robotics and AI. arXiv, as expected, contributes unique methodological and domain-specific terms, pointing to ongoing innovation and theoretical advancement.

These differences may reflect the varying functions, interests, and goals of each community. The overlap in certain keywords suggests opportunities for cross-pollination of ideas, while the unique terms highlight areas where further integration or communication could be beneficial. The prominence of topics like emotional intelligence and autonomous driving also suggests that the field is rapidly evolving, with new challenges and opportunities emerging at the intersection of technology, society, and research.

Overall, the analysis underscores the value of a multi-platform approach for capturing a holistic view of emerging trends in robotics and AI. It also points to the importance of fostering dialogue between communities to accelerate progress and address complex, interdisciplinary challenges.

7 Threats to Validity

The validity of this research is subject to several potential threats, which are discussed below:

1. Data Collection Bias: The selection of keywords and the reliance on platform-specific APIs may introduce sampling bias. Not all relevant discussions or repositories may be captured, especially if they use alternative terminology or are restricted by API limitations. Additionally, the exclusion of non-English content may limit the generalizability of findings to global trends.

2. Platform Representation: Each platform serves a distinct audience and purpose, which may skew the types of content and discussions analyzed. For example, GitHub emphasizes code and technical documentation, Reddit focuses on community discussions, Stack Overflow centers on problem-solving, and arXiv targets academic research. This inherent heterogeneity may affect the comparability of extracted keywords and trends.

3. Keyword Extraction Limitations: The use of the YAKE algorithm, while effective for unsupervised keyword extraction, may not fully capture nuanced or context-dependent terms. The choice of n-gram size and the number of keywords extracted can influence the results, potentially omitting important but less frequent topics.

4. Temporal Validity: The analysis is based on data collected within a specific timeframe (post-2019-12-31). Emerging trends may shift rapidly, and the findings may not reflect longer-term or future developments in robotics and AI.

5. Data Cleaning and Preprocessing: The removal of stop words, personal names, and other filtering steps, while necessary for clarity, may inadvertently exclude relevant technical terms or introduce inconsistencies across platforms.

6. Interpretation Bias: The aggregation and interpretation of keywords involve subjective decisions, such as grouping similar terms or inferring thematic relevance. These choices may affect the conclusions drawn from the data.

7. External Validity: The focus on four major platforms, while comprehensive, does not encompass all possible sources of robotics and AI discourse. Excluding platforms like Twitter, LinkedIn, or specialized forums may limit the scope of identified trends.

To mitigate these threats, the study employed consistent data processing pipelines, parameterized keyword extraction, and transparent reporting of methods. Nonetheless, future work should consider expanding data sources, refining extraction techniques, and conducting longitudinal analyses to enhance the robustness and generalizability of the findings.

8 Related Work

Previous research highlights several key features that users value in robotic pets and social robots, including companionship and emotional support, interactivity and intelligence, ease of use, customization, and physical design. These features are especially important for vulnerable populations such as older adults and children with anxiety, who benefit from comfort, companionship, and emotional alignment provided by robotic companions [2, 3, 7]. Interactivity and intelligence—such as emotion detection, realistic behavior, and the ability to respond to user actions—are also highly valued [3]. Accessibility is enhanced by simple interfaces, minimal maintenance, and intuitive operation [11], while customization of the pet's personality and responses further improves user satisfaction [4]. Physical attributes like soft textures, expressive eyes, and realistic movements contribute significantly to the user experience [4, 11].

Several studies have demonstrated the positive impact of robotic pets and socially assistive robots (SARs) on well-being. For example, Norina et al. [7] found that interventions with robotic pets can help mitigate loneliness by acting as social companions, increasing social interaction, facilitating remote communication, and reminding users of upcoming social activities. Social robots have also been shown to improve the health of children experiencing anxiety by providing social alignment between the robot and the child [4], and to help older adults with dementia by providing companionship and opportunities for social interaction [3].

Beyond emotional support, recent research has explored the integration of emotional intelligence and advanced AI capabilities into social robots. Abdollahi et al. [1] found that integrating emotional intelligence into the socially assistive robot Ryan enhances its effectiveness and likability in supporting older adults with depression and dementia. Studies in healthcare and education contexts also highlight the importance of emotional AI for improving user experience and outcomes [8, 9, 13].

The design and behavior of robots play a crucial role in user acceptance and effectiveness. Xie and Luh [14] note that while many non-humanoid robots are task-oriented, they can also display visible emotional content through movement patterns and simulation effects. Paluch and Müller [11] report that nursing home residents feel relaxed when interacting with robotic pets, and that the exterior design of the robot is suitable for integration into daily care routines. Riddoch [12] emphasizes that animal-like behaviors, such as communication, consistency, predictability, physical affection, and positivity, are valuable for implementing social roles in robots.

Recent advances in robotics and AI have also focused on enhancing robots' ability to interact naturally with humans. For example, Yu et al. [16] developed a Human Emotion and Intention Aware Path Planner (EmoiPlanner) to enable robots to adapt to people's emotions and intentions in navigation tasks. Fatahi [5] compared emotional tones in ChatGPT and human answers on Stack Overflow, finding that ChatGPT's responses are more consistently positive, while human replies show greater emotional diversity. Gao et al. [6] introduced GesGPT, a gesture synthesis method using large language models to generate expressive gestures from speech or text. Ye [15] presented RoboGPT, a ChatGPT-powered control system that enhances trust and communication in human-robot collaboration through natural language interaction, and Koubaa et al. [10] proposed a ROS2-based system leveraging ChatGPT for natural language command execution in robots.

Additionally, Bharatharaj et al. [2] designed a parrot-inspired robot, KiliRo, capable of classifying and recognizing terrain based on images and notifying users of potential dangers. These findings collectively suggest that robotic pets and social robots should balance emotional, functional, and aesthetic features to meet user expectations and enhance their effectiveness in various social, care, and technical contexts.

9 Conclusions

In summary, this study systematically identified and compared emerging technical trends in robotics and AI by extracting and analyzing keywords from GitHub, Reddit, Stack Overflow, and arXiv. The results demonstrate a strong convergence around topics such as large language models, human-robot interaction, and generative AI, reflecting their centrality across both research and practitioner communities. At the same time, platform-specific focuses—such as implementation and troubleshooting on GitHub and Stack Overflow, social and ethical discussions on Reddit, and methodological

innovation on arXiv—highlight the diverse perspectives and contributions of each community.

These findings directly address the research question by revealing both shared and unique trends across platforms, underscoring the value of a cross-platform approach for capturing the multifaceted evolution of robotics and AI. The analysis suggests that ongoing dialogue and collaboration between communities can further accelerate progress and foster innovation in this rapidly advancing field.

10 Future Work

Based on the findings of this study, several directions for future research are suggested:

- **Longitudinal Analysis:** Extend the temporal scope to analyze how technical trends in robotics and AI evolve over time across platforms, identifying emerging topics and shifts in community focus.
- **Inclusion of Additional Platforms:** Incorporate other relevant platforms such as Twitter, LinkedIn, or specialized robotics forums to capture a broader range of discussions and perspectives.
- **Deeper Semantic Analysis:** Apply advanced natural language processing techniques, such as topic modeling or contextual embeddings, to uncover deeper semantic relationships and latent themes within and across platforms.
- **User and Community Segmentation:** Investigate how different user groups (e.g., researchers, practitioners, hobbyists) contribute to trend formation and dissemination, and how their interests differ.
- **Impact Assessment:** Examine the real-world impact of identified trends by linking online discussions to tangible outcomes, such as published research, open-source projects, or industry adoption.
- **Ethical and Societal Implications:** Explore in greater depth the ethical, legal, and societal dimensions of emerging trends, particularly as they relate to human-robot interaction and generative AI.
- **Automated Trend Monitoring Tools:** Develop automated systems for real-time monitoring and visualization of technical trends, enabling stakeholders to stay informed about rapid developments in robotics and AI.

These directions can help build a more comprehensive and dynamic understanding of the evolving landscape of robotics and AI, and foster greater collaboration between research, industry, and the broader community.

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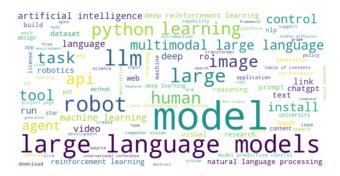
Figure 5: Word Cloud for GitHub

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A Appendices

A.1 Word Clouds

The word clouds in Figures 5, 6, 7, and 8 visualize the most frequently occurring keywords extracted from each platform, providing an intuitive overview of the dominant themes and trends in robotics and AI discussions.

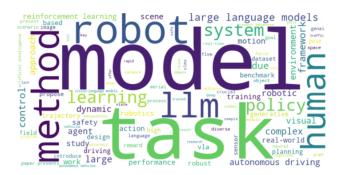**Figure 6: Word Cloud for Reddit**

Figure 8: Word Cloud for arXiv

Figure 7: Word Cloud for Stack Overflow

A.2 Code

The code used for data collection and analysis is available on GitHub:
https://github.com/ZuxingGit/LaTex/blob/master/assignment/ResearchMethod/
ResearchPaper/scraper2.ipynb.