Exploring the Impact of Technology on Human Interaction and Engaging Business Needs Through Software Design Patterns

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Abstract: This paper explores the impact of technology on human interactions by integrating software engineering patterns to address business needs. A specialized development environment is proposed to enhance collaboration, focusing on bridging the technical and business perspectives through adaptable patterns. By leveraging classic and emergent software patterns, the approach supports real-time feedback and iterative improvements, enabling agile development practices that align with evolving user and business requirements. Key contributions include a modular framework for improved team communication and a Conceptual Framework on Human Interaction (CFI), along with an Embedded Business and Safety Human-AI Interaction Pattern (EBSH-AI). These tools aim to enhance interaction across technical and business domains while addressing ethical considerations in AI, such as privacy and authenticity in lifelike avatars. The findings indicate that structured software patterns improve cross-functional communication, fostering productivity and trust in AI-driven environments. This research provides a pathway to more meaningful interactions and user-centered outcomes in software engineering, with particular emphasis on the emerging role of AI avatars in the Metaverse and their impact on business and social engagements.

Keywords: AI avatar and Metaverse applications, business engineering, and technology, human interaction, patterns, software development, team collaboration

Introduction

Aligning software development with strategic business objectives is a challenging and ongoing task as digital demands increase in healthcare, banking, and transportation. As a result, sectors important to human existence must constantly improve operations [1]. What implies the possession of corporate strategies to shorten time to market, and improve user experiences by using knowledge management and continuous integration and continuous delivery/continuous deployment (CI/CD) [2, 3, 4]. However, ongoing communication gaps between technical teams and business units can jeopardize these objectives, and various standards and legal norms may be violated [5, 6]. Divergent terminologies, priorities, and methodologies inhibit efficient collaboration, often resulting in misalignment of projects and costly delays [6, 7, 8].

Traditional development approaches cannot respond quickly to changing global needs, which has a limiting influence on agile solutions in high-impact businesses. This research proposes a more efficient development environment and communication structure based on certain software engineering principles [7, 8]. This strategy involves linking technological and business sectors. They must foster efficient cross-functional collaboration, leading to faster, more reliable implementations that meet the strategic and operational needs of industries crucial to modern life [9, 10, 11].

Every notion in today's business, based on new technologies, necessitates a strategic initiative that

integrates various types of digital technology and human connection across all divisions of the corporation. Identify solutions to improve operational efficiency and accelerate the commercialization of products or services [12]. In this scenario, we are primarily would be employing the Model-View-Controller (MVC) software architectural pattern, which is commonly utilized in the design and development of user interfaces. MVC separates a program into three interconnected components, each with a specific task, to promote modularity and scalability. One of the current trends and ''problems'' that will soon emerge is the creation of AI avatars, which will surely influence how humans interact with computers and machines in general. This leads to the fact that it will be difficult to distinguish between a human and an AI model that is being communicated with [13]. Artificial intelligence (AI) supports the operation of most corporate and educational technologies and systems, transforming everything we use and generate daily into the new post-digital society [14].

AI avatars and adaptive AI systems are increasingly being integrated into everyday interactions, from customer service to personal wellness. This is modifying human behavior patterns in unexpected ways [15]. Because these AI-powered interfaces resemble human expressions and conversational patterns, people commonly respond to them with familiar social cues, viewing robots as quasi-human alternatives. The issues of AI in the Metaverse include ensuring realistic interactions, maintaining user privacy, and addressing ethical concerns about immersive AI avatars. AI avatars represent users or virtual entities that impact social dynamics and behavior. The achievement of lifelike avatars that respect user limitations and promote engagement requires powerful AI and explicit ethical norms [16].

The proposed research is organized in the following sections and contains certain logical units: introduction, literature review, contributions and novelty, materials and methods, software design patterns costs, results, limitations of the study, discussion, and conclusion.

Literature Review

There is numerous research demonstrate the effectiveness and importance of technology as a significant impact on human interaction in business and software development. The study carried out by Walliser et al. [17] explores how AI improves human-computer interaction, enhancing team involvement and creating efficiency in team collaboration. Silva et al. [18]describe the importance of technology to understanding user needs and challenges in designing effective mobile interactions [19].

To give a more comprehensive overview of the available literature, we have created appropriate subsections that contain information pertinent to our research topic, the interaction of people, machines (computers), and their influences. Based on the above, we implemented the following organization:

1. Technology and important effects on human interaction
2. Specific engagement designs impact
3. Topic of interest in various industries
4. Evolving digital landscape

Technology and important effects on human interaction

Kong et al. [19] describe that technology has important effects on human interaction, whereas Walliser et al. [17] and Mohapatra et al. [20]show that technology including AI and chatbots improve decision-making in business.

Alshuridehet et al. [21] describe the effectiveness of technology in improving marketing performance and customer confidence in the business, also human interaction minimizes bias in AI systems and is critical for encouraging user trust and effective involvement in business enhancement [22].

Ahsan and Junaid [23] study the dynamics of human interactions and propose the use of communication, and quality work to improve collaborative processes in organizations [24].

Specific engagement designs impact

Fasano et al. [25], Jung et al. [26], and Pennathur et al. [27] found that while digital tools improve information collecting in bank-firm partnerships and bank crisis, human contact is still required to minimize data differences and assure effective financial settlements are considered.

Studies by Wu et al. [28], Branzoli et al. [29], and Dou et al. [30] highlight that technology's impact on human contact in corporate contexts is frequently dependent on specific engagement designs, and Sima et

al. [31] and Dell'Acqua et al. [32] support the role of structured digital tools, AI and adopting technologies in building communication, decision-making, and organizational connection as an important part for business growth.

Topic of interest in various industries

The impact of technology on human interaction has been a topic of interest in various industries. As such, Malik et al. [33], conducted a case study on Amazon to analyze the impact of Virtual Reality (VR) on product sales in the customer relationship management sector.

Pfnür et. al. [34] explored the transformation of the real estate and construction industry, highlighting the pressure to adapt existing business models and the opportunities for further development. Also, Sykes et. al. [35] emphasized the importance of digital spaces in interlanguage pragmatics, stressing the need for language learners to engage in digital communities for success in a technology-saturated world.

Furthermore, Bandaragoda et. al. [36] proposed an Artificial Intelligence-based commuter behavior profiling framework using the Internet of Things for real-time decision-making, aiming to optimize operations through the analysis of commuter behavioral patterns.

Visconti et. al. [37] delved into healthcare digitalization and pay-for-performance incentives in smart hospital project financing, investigating the impact of digital health on project financing and supply chain bottlenecks. Shoesmith et. al., [38] investigated the impact of interactions between humans and animals on mental and physical health during the COVID-19 lockdown period in the United Kingdom, emphasizing the value of such partnerships during difficult times.

Evolving digital landscape

Chandra et. al. [39] theorized the role of human-like competencies in conversational AI agents, focusing on user engagement and the mediating role of user trust in these relationships. Touriano et. al., [40] investigated the effects of technological advances on talent management operations, particularly the installation of a human resource management system to improve efficiency and effectiveness. Lastly, Gao et. al., [41] investigated the visual impact of character components in digital human guides for tourism, using eye-tracking technology to see how different elements influence user focus and interaction. The findings of this research highlight the relevance of technology in altering human relationships and corporate demands, underlining the necessity to leverage patterns and innovative techniques to adapt to the changing digital landscape.

Contributions and Novelty

We investigate how technology influences business needs and human interaction by analyzing domain-specific organizational patterns as potential solutions for both industries and academia. To address the challenges identified in our study regarding technology's effects on human interactions, we developed a new framework. This framework highlights the similarities among various patterns and their implications for effective communication and collaboration. Our research not only uncovers existing gaps in current technological processes but also offers actionable recommendations for organizations to better identify their business needs and adapt to evolving demands. The main contributions include:

1. Developed a framework to identify the impact of technology on human interaction
2. Composing patterns as pattern language for solving recurring problems
3. Provide solutions to mapping technology to business via organizational patterns
4. Adopted design patterns and connected them with organizational patterns to identify business needs
5. Analyzed the association between design and organizational patterns
6. Identify business needs through technology and human interaction.

Materials and Methods

The proposed research method offers a structured framework for examining the intersection of software engineering patterns, human interaction, and the metaverse. A mixed-methods approach will be used to analyze the impact of software patterns and AI avatars on communication between technical and business teams.

The study will conduct a comprehensive literature review to identify key themes, challenges, and solu-

tions in communication frameworks, particularly in the context of the metaverse. Sources will include peer-reviewed articles, industry reports, and case studies. By analyzing the literature and offering actionable insights, the study aims to improve communication, enhance project outcomes, and better align technical solutions with business objectives in software engineering, artificial intelligence, and metaverse environments.

Selection Criteria

The selected literature focuses on communication approaches, software engineering patterns, and human-computer interaction. Industries such as automotive, telecommunications, psychology, development technology, and healthcare significantly impact our daily lives. We prioritized peer-reviewed studies and ongoing research that explore the psychological challenges of balancing human needs with technology. These studies often reveal that people's relationships with computers are complex and sometimes unclear. Additionally, there are negative effects on concentration and attention during interactions.

Foundational papers are based on software patterns that provide a basis for present and future design concepts. The collected case studies provided us with some practical, human-centered applications. By providing information on emerging technologies such as virtual interfaces, artificial intelligence (AI), and holograms. We investigate the evolving interplay between humans and robots, providing new insights into how to improve team alignment and communication in technologically advanced situations.

Keywords

To properly construct the search procedure, we used the following keywords and terms:

1. Applying organizational patterns in human interaction to identify business needs
2. Human-computer interaction and innovative AI avatars
3. Communication Frameworks and Human Psychological Effects
4. Health and communication issues in software engineering patterns.
5. Cross-functional alignment in sustaining attention throughout communication
6. Emerging collaborative technologies and current trends in the automotive, healthcare, and IT sectors

Questions

1. How can software patterns improve communication between technical and business teams?
2. What development features support agile alignment with business goals?
3. How do communication frameworks affect efficiency and customer satisfaction?

SOFTWARE DESIGN PATTERNS COSTS

Software design patterns affect the architecture of many software systems. This underscores the importance of design patterns in developing software for electric vehicle charging management platforms and many industries in general [42, 43]. Similarly, immersive visual scripting based on VR software design patterns is offered for experiential instruction, emphasizing the use of novel software design patterns to replicate behavioral tasks in VR experiences [43]. However, on the other side, we must address the concept of resilience design patterns in extreme-scale high-performance computing systems, emphasizing the importance of established methodologies for detection, mitigation, and recovery. Focus on architecture anti-patterns that create considerable maintenance costs in large-scale software systems, emphasizing the importance of adhering to key design principles to avoid them [44].

Furthermore, investigating the energy cost of AI design patterns, illustrating the difference in energy consumption that may be achieved by selecting the appropriate design pattern for IoT applications and energy systems [45]. We should also examine how the Decorator pattern affects energy consumption, emphasizing the need to adjust software designs for greater efficiency. Software design patterns are essential across various fields, such as electric vehicle charging management and VR software for high-performance computing. These findings underscore the importance of choosing the right design patterns to optimize software systems and cut costs.

In this section, we'll explore the factors that influence custom software development expenses. Precise cost assessment is challenging, as one decision can either drive up costs or reduce them when approached thoughtfully. Careful cost monitoring is essential to

prevent budget overruns and ensure resources are allocated effectively shown on Figure 1. Our goal is to provide short guidance for making well-informed, strategic decisions.

We'll also discuss significant unavoidable expenditures (Figure 1), such as those associated with the technology stack, emphasizing the significance of recognizing and managing these expenses. Certain expenditures are unavoidable, regardless of the size or type of the software product. These include charges for your tech stack, third-party services, and more, all of which have an impact on your total budget. We can look at these key cost issues more closely [46]:

1. Tech Stack Costs: certain expenditures cannot be avoided, regardless of the size or type of your software product. These include expenses associated with your chosen tech stack, third-party services, and more, all of which can have a substantial impact on your entire budget
2. Back-end Development: Back-end development can cost a lot of money, depending on how complicated your service or product is. Python coders in Eastern Europe typically charge around $40-$55 per hour. If we hunt for a more sophisticated language, like Java, the cost may increase to roughly $50-$65 per hour.
3. Front-end Development: JavaScript is still a popular front-end programming language in Eastern Europe, with hourly rates ranging from $35 to $50
4. Mobile app development: can be done using Swift for iOS (about $45-$55 per hour) or Kotlin for Android (around $40-$50 per hour).

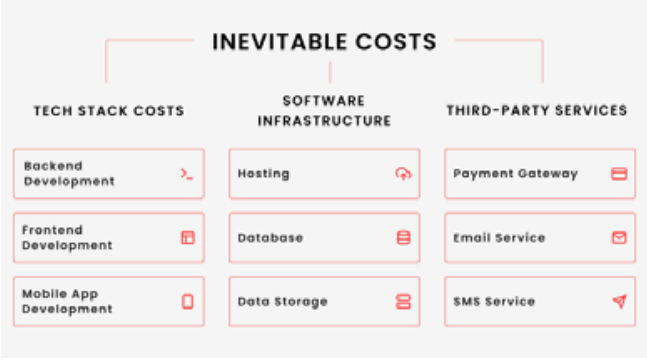

Figure 1. *Unavoidable Costs Accounting for the Price of Technology Stack. Source: [46].*

Outsourcing a project to an Eastern European company can result in a total labor cost of approximately $80,000 (or less, depending on the type of development) [48]. Outsourcing custom software development appears to provide a significant cost advantage, even after accounting for project administration and other potential costs [46]. A junior Java programmer from a particular country will earn a different hourly rate than a senior programmer from another. For example, a senior Java programmer in the UK earns an average of €35.06 per hour [46].

Results

The proposed framework combines design patterns, such as Observer, Adapter, and Model-View-Controller (MVC), with organizational patterns to enhance human interaction through technology and address business needs across software companies and industries [47, 48] . We also use patterns such as Community of Trust, Developer Control Process, and Engage Customers. This method allows us to identify and meet business requirements by mapping human interactions with technology. This methodical usage of patterns allows us to more effectively identify and handle company demands.

This shift has a subtle impact on users' views of real-life interactions, occasionally heightening expectations of speed and precision in human exchanges. However, as these technologies progress, they raise questions about privacy, ethical boundaries, and possible dependency. Finding a balance between innovation and ethical controls will be critical to AI's position in human-centered situations.

The Conceptual Framework for Human Interaction (CFI), illustrated in Figure 2 outlines the arrangement of teams, businesses, and clients, providing solutions to various challenges. The figure demonstrates how Agile teams, Human-Computer Interaction (HCI), design principles, and organizational patterns influence human interaction and fulfill business needs. The flow from steps 1 to 12 clarifies how these components facilitate meaningful human engagement and achieve corporate objectives through technologies like Virtual Reality (VR) and the metaverse.

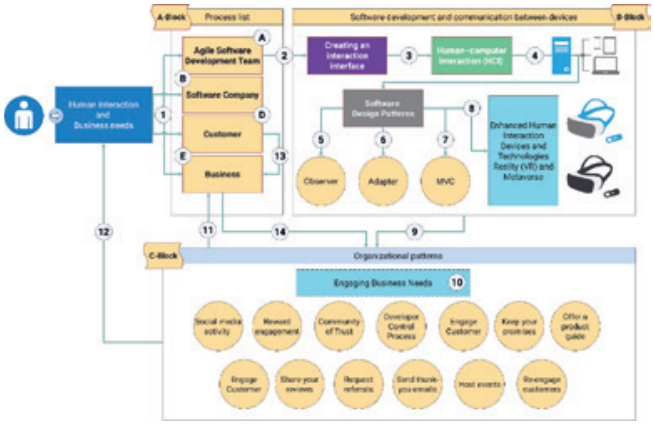

Figure 2. *Conceptual framework for human interaction (CFI). Source: author's contribution.*

The framework demonstrates how technology impacts business through improved human interaction. The Observer design pattern enhances responsiveness to user inputs in real-time. The Adapter pattern allows for seamless integration of business components, while the MVC pattern increases transparency by separating user interactions from backend code. By incorporating organizational patterns that strengthen relationships between Agile teams, customers, and software companies, the framework effectively identifies business needs and fosters collaboration. This integration of design patterns establishes a technological environment that supports human interaction. It enables users to engage with technology and emphasizes the importance of user involvement in software development, ultimately building trust and ensuring quality outcomes.

In response to recent technological advancements, including AI avatars, the proposed Embedded Business and Safety Human-AI Interaction Pattern (EBSH-AI) as illustrated in the Figure 3 serves as a framework for software production. It combines design and organizational patterns to outline a process for identifying business needs while mapping the impact of technology on human interaction. Businesses are increasingly challenged by growing technology demands, the need for skilled employees, and potential risks in software production.

The EBSH-AI framework integrates design patterns such as the Observer, Adapter, and MVC. Where we connect the organizational patterns such as Developer Control Process, Community of Trust, and Engage Customer [47, 48]. This combination provides flexible, adaptable guidelines that can anticipate requirements, analyze data in real-time, and enhance the efficiency of interactions with business demands and technological support. These patterns empower EBSH-AI to tackle recurring challenges and deliver long-term strategic solutions. The proposed EBSH-AI patterns, shown in Figure 2 and Figure 3, help identify business needs through human interaction and AI avatars while enhancing safety measures. This approach assembles organizational and design patterns to create a cohesive framework.

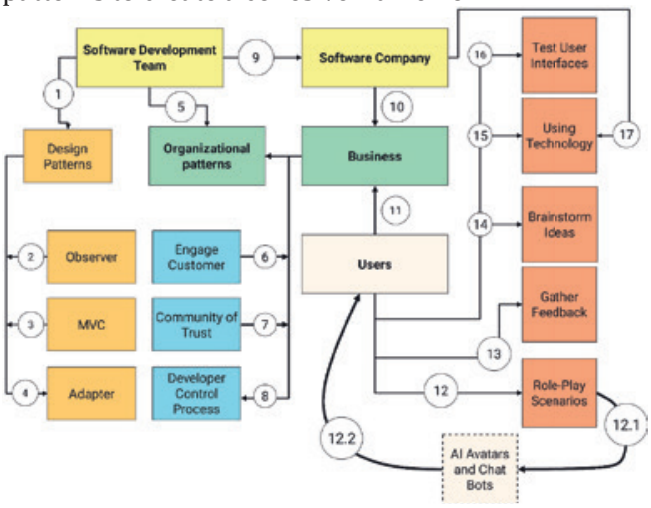

Figure 3. *Embedded Business and Safety Human-AI Interaction Pattern (EBSH-AI) as Framework for software development, as well as organizational and design patterns. Source: author's contribution.*

Connecting the presented approach and the implementations themselves, we can present them in the following way [51, 52]:

1. **Software Company:** A software company aims to develop products based on customer requirements and preferences. It connects the software development team with customers, users, and stakeholders to identify business needs in response to rapid technological growth.
2. **Software Development Team:** The software development team is crucial in defining business requirements and bridging the gap between business and technical domains. They utilize design and organizational patterns to make the most of company resources and improve business connections.
3. **Design Patterns:** Our approach incorporates design patterns that serve as reusable solu-

tions for common software design challenges. These patterns simplify technical processes, making the code more flexible and maintainable for long-term support and enhancement.

4. **Observer Pattern:** In our context, the Observer pattern is used when a subject needs to notify multiple observers about changes in its state. When users interact with the system and perform actions, any change triggers updates to the observers, keeping them informed of the new state.
5. **MVC Pattern:** The Model-View-Controller (MVC) design pattern simplifies business and application logic. It manages data and user views effectively, providing an organized interface for user interactions. This allows businesses to receive feedback from user engagement while supporting developers in maintaining logical flow within the software product.
6. **Adapter Pattern:** The adapter pattern in our framework demonstrates how technology influences human contact and addresses business demands more comprehensively.
7. **Software Organizational Patterns:** Utilizing organizational patterns helps align the software company with the business and connect customers with the Agile team. These patterns facilitate efficient and safe collaboration, bridging the gap between business and software companies to easily identify and address challenges.
8. **Engage Customer:** We employed this organizational pattern to enhance customer participation and involvement. This fosters a collaborative working environment between the software development team and customers. Effective communication between the agile team and customers is essential to achieving the project's common goals. Both parties are encouraged to work together, allowing customers to design, select features, test the product, and actively participate in the development process.
9. **Community of Trust:** Building a strong relationship between the software company and the business requires trust, respect, and mutual understanding. A Community of Trust is vital for sharing knowledge between partners. This pattern creates an environment of mutual respect and transparency, empowering team members to collaborate openly and share responsibility for project outcomes.
10. **Developer Control Process:** It is important to give technical staff, particularly the agile team, the freedom to use resources effectively. The Developer Control Process pattern allows developers to understand their roles and take ownership of their work. This freedom fosters accountability and innovation within the team, improving product quality and streamlining processes for better results.
11. **Business:** Effective communication between the software company and the business is essential to identifying business needs. It helps meet customer expectations and supports human interaction with technology, contributing to global business growth.
12. **Users:** Users are key stakeholders in the software product. They help improve system performance, provide feedback for further enhancements, and share business requirements.

    12.1. AI Avatars and Chat Bots: AI avatars and chatbots enhance user engagement by providing personalized interactions and instant responses. These technologies simulate human-like conversations, improving customer support and user experience.

    12.2. Enhanced Human Interaction Devices: Immersive devices like virtual reality (VR) and the metaverse create enriched environments for social interaction. They enable users to connect and collaborate in innovative ways.
13. **Test User Interface:** Evaluate the user interface design and services. Ensure it works based on user preferences, is responsive, and meets both user expectations and company standards.
14. **Using Technology:** Recent technological advancements have transformed business operations. They have significantly enhanced industries and academia while providing users with better support to work efficiently. Users, businesses, and software companies need to

stay updated with technology to prevent security breaches.

15. **Brainstorming Ideas:** We focus on creating a collaborative environment among teams, industries, and customers. This encourages knowledge sharing, idea generation, and open discussions with all stakeholders.
16. **Gather Feedback:** Gathering feedback is crucial for improving processes and software products. It enhances collaboration between teams and customers and helps identify gaps between businesses and software companies.
17. **Role Play Scenarios:** Role play allows individuals to engage with different roles and characters. This opportunity helps them learn and explore interactions effectively in the workplace.

Listing 1: *The MVC design pattern describes user interaction by notifying several classes about customer service, user engagement, and other events. Source: author's contribution.*

```
1    Interface IObserverCreater
2    Method Update(detail)
3
4  Class UserInteractionToSystem
5    List<IObserverCreater> observers
6
7    Method AddObserver(observer)
8      observers.Add(observer)
9
10   Method NotifyObservers(detail)
11     For observer in observers
12       observer.Update(detail)
13
14   Method TriggerInteraction(detail)
15     Print detail
16     NotifyObservers(detail)
17
18 Class Analytics, CustomerService,
19 Marketing implements IObserverCreater
20   Method Update(detail)
21     Print "[Type] " + detail
22
23 Main
24   ui = UserInteractionToSystem()
25   ui.AddObserver(Analytics())
26   ui.AddObserver(CustomerService())
27   ui.AddObserver(Marketing())
28   ui.TriggerInteraction("User
       purchased an item.")
```

The Observer design pattern used in our approach defines a user interaction class that notifies multiple observer classes. These observers include analytics, customer service, user interaction, query response, and marketing. This architecture enables them to effectively react to user interactions with the system.

Listing 2: *the Adapter pattern shows the analytic and processing data, the algorithm shows the legacy and analytic system data process. Source: author's contribution.*

```
1    Interface IAnalyticsProcess
2    Method Process(data)
3
4  Class ModernAnalytics implements
     IAnalyticsProcess
5    Method Process(data) Print
       "Processing: " + data
6
7  Class AdoptingLegacyData
8    Method Get() Return "Legacy Data"
9
10 Class AdoptingLegacyData implements
     IAnalyticsProcess
11   LegacyData legacy
12   Constructor(AdoptingLegacyData
       legacy)
13   this.legacy = legacy
14   Method Process(data)
15   Print "Adapting: " + legacy.Get()
16
17 Main
18   ModernAnalytics().Process("Modern
       Data")
19   LegacyAdapter(
20   AdoptingLegacyData()).Process("")
```

The following code presents the algorithm for the Adapter design pattern in Listing 2. This listing demonstrates how modern analytics for data processing can adapt legacy system data through compatibility with the adapter class, as illustrated in the Figure 3. To provide more clarity, we can use the following definition of the pattern groups: the Design Patterns section (view), which includes Observer, MVC, and Adapter. The pseudocode shows that implementing the adapter pattern allows the current interface to be used alongside an existing interface. It explains how the modern analytics system processes data while

the legacy system's data is made compatible through the adapter class.

Listing 3: *Implementing MVC design pattern, Source: author's contribution.*

```
1
2     Class UserInteractionToSystem
3     Property Id
4     Property InteractionDetail
5     Property Timestamp
6
7     Method GetUser Interactions()

8     Return List of sample
          UserInteraction
9
10  Class AnalyticsViewProvider
11    Method
          DisplayInteractions(interactions)
12    Print "User Interactions Report:"
13    For each interaction in
          interactions
14    Print "ID: " + interaction.Id +
          ", Detail: " +
          interaction.InteractionDetail
          + ", Time: " +
          interaction.Timestamp
15
16  Class AccessUserInteractionController
17    Constructor(model, view)
18    this.model = model
19    this.view = view
20
21    Method UpdateView()
22    interactions =
          UserInteractionToSystem.GetUser
          Interactions()
23    view.DisplayInteractions(
24    interactions
25    )
26
27  Main
28    controller =
          AccessUserInteractionController(
29    UserInteractionToSystem(),
30    AnalyticsViewProvider()
31    )
32    controller.UpdateView()
```

The following pseudo-code explains the MVC design pattern. In this pattern, the user interaction class acts as the model, managing the user data for processing. The AnalyticsView class is responsible for displaying the gathered data. Meanwhile, the User Interaction Controller facilitates the interaction between the model and the view, ensuring the relevant data is displayed correctly.

Limitations of the Study

Using organizational patterns to address general business problems can limit the effectiveness of our proposed framework. Therefore, we identified different working environments tailored to business needs while engaging customers in the development process. We provided agile teams with access to resources and developed solutions for specific recognition problems through our framework, which combines design and organizational patterns.

Our research indicates that the specific organizational approach we investigated may limit the generalization of findings across various business settings. Additionally, the rapid pace of technological change can render some patterns irrelevant or require them to be adapted as businesses grow and evolve. This variability can affect the study's applicability in different technological environments. Nevertheless, our approach connects business with technology and enhances human interaction through the application of patterns. However, the effectiveness of this approach may vary based on individual business culture and levels of engagement.

Patterns are established solutions to the recurring challenges in managing people, code, and business processes. Without knowledge of these patterns, individuals unfamiliar with them may struggle to implement solutions effectively. This study faces limitations due to a lack of sufficient research on the impact of software patterns, design patterns, organizational patterns, and AI avatars on communication between technical and business personnel. There is also limited research on how to combine design and organizational patterns to create effective solutions.

Additionally, the rapid advancement of technology means that much previous research may be outdated. Differences between industry and academic contexts can limit the generalizability of our results. Challenges in participant recruitment may also restrict the di-

versity of perspectives. Relying on self-reported data, exploring unknown domains, and the lack of knowledge may introduce bias. Furthermore, the limited number of case studies may not fully represent the core ideas of software products, their implementation, and outcomes, which can differ significantly.

DISCUSSION

Organizational success is strongly reliant on efficient communication frameworks and the integration of quickly changing technologies. The value of software in these industries cannot be emphasized, as it allows for more efficient operations, improves data management, and aids decision-making processes. Teams can increase interactions and collaboration across technical and business groups by using software engineering patterns, design patterns, and organizational patterns. This method helps projects meet deadlines and fosters a collaborative agile culture focused on attaining common goals.

Despite these attempts, misconceptions can result from the usage of specialist technical jargon. This issue emphasizes the need for a more accessible common language to bridge the communication barriers between people, technology, and business. Visual aids, virtual technology, and creative tools such as holograms can all be incredibly useful for simplifying complex concepts and encouraging real-time engagement. To successfully employ these strategies, firms must embrace a mindset that values ongoing feedback and iterative procedures. Moving forward, research should look into how communication mechanisms evolve and the long-term effects of these frameworks on team dynamics and adaptability in different contexts.

According to the research conducted, we were able to obtain the following information regarding the previously asked questions:

RQ 1:

The findings indicate that applying software patterns enhances communication between technical and business teams. These patterns provide structured frameworks that clarify roles, responsibilities, and processes. For example, patterns like Community of Trust and Engage Customer to improve information flow and reduce misunderstandings, ensuring all stakeholders stay updated in real-time. They bridge the gap between technical jargon and business objectives by promoting a shared vocabulary.

Additionally, visual representation tools linked to these patterns help clarify complex ideas and foster collaboration. Overall, using software patterns leads to better alignment, increased efficiency, and a more collaborative work environment.

RQ 2:

Our investigation revealed that agile alignment with business goals relies on iterative development cycles and collaboration tools for real-time communication. We found that incorporating AI and virtual reality (VR) enhances user engagement and provides deeper insight into user behavior. Prioritizing user stories and performance metrics helps teams deliver value and adapt to changing needs.

RQ 3:

Our investigation revealed that effective communication frameworks boost efficiency and customer satisfaction. Through our approach(s) and work on the code, we gained interesting insights into the interaction between human-computer interfaces and users. These insights highlighted clear reasons for change, enabling quick responses to customer needs and fostering stronger engagement.

We believe that future research in this area will focus on improving human-computer interaction through sophisticated AI and immersive technologies, resulting in more intuitive and seamless communication frameworks that bridge the gap between users and devices.

Open Questions

As a guiding idea for future research, we can provide three straightforward open questions for future research, which we believe have not yet been adequately investigated:

1. How will AI avatars affect communication skills and human-computer interaction among young users?
2. What ethical frameworks ensure privacy in AI interactions?
3. How software design patterns and organizational patterns compositions can improve quality in human interaction with business needs?
4. How can we design future AI avatars to enhance user experience without dependency?

We discovered that software patterns promote collaboration among technical and business teams. AI avatars can help to bridge communication barriers and improve user experiences. However, we must create ethical frameworks to protect privacy and authenticity in AI interactions, while also conserving real-life social skills and avoiding over-reliance on technology. The future working hypothesis and discussion box serve as a conceptual framework or forum for ongoing dialogue. As a study on the impact of AI avatars on communication and social behavior, particularly among younger users. This entails a proactive approach to hypothesize possible outcomes and sparking discussions.

Conclusion

This study emphasizes the importance of software engineering patterns in improving communication between technical and business teams, especially in high-impact areas. Organizations may improve cooperation, streamline interactions, and better match their goals with business demands by merging design and organizational patterns. The presented frameworks address common difficulties in the literature, resulting in better project outcomes and higher customer satisfaction.

As AI avatars become more prevalent in digital interactions, particularly in immersive environments such as the Metaverse, an emphasis on safety and ethical norms is critical. This study integrates technology, ethics, and human psychology, implying that well-designed AI interfaces can improve user experiences while preserving real-world social skills. Furthermore, our research shows that software patterns can bridge communication gaps, although the ethical implications of AI interactions remain a major concern.

Future research should look into the psychological and social effects of AI technologies on younger generations, including empathy and social conduct, as well as the ethical frameworks required to maintain privacy and authenticity in these interactions. Addressing these issues will pave the path for more inclusive, human-centered AI development across multiple industries. Future research may look into the changing impact of AI avatars on user experiences, social dynamics, and the effects of technology on human behavior in everyday interactions. Furthermore, research might examine how these tools affect ethical decision-making and personal interactions in increasingly digital worlds.

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Not applicable

Conflict of interest
The author(s) declare(s) that they have no conflict(s) of interest.

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