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IMPROVED SCRUM-TREE-K-NEAREST NEIGHBOR'S ALGORITHM: A DYNAMIC APPROACH TO MITIGATE RISKS IN DISTRIBUTED AGILE DEVELOPMENT

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Abstract: Distributed agile development in multi-national projects brings with it a number of issues, including higher risk and decreased predictability. To solve these issues, this work introduces the Scrum-tree-k-nearest neighbor's algorithm, which combines Scrum principles with the k-nearest neighbor's method to dynamically assign resources in agile development projects. Scrum is a system for managing complex goods and solutions that is iterative and progressive. The k-nearest neighbour method is a machine learning approach that distributes resources dynamically depending on task proximity. The Scrum-tree-k-nearest neighbour method delivers a dynamic, flexible, and adaptable approach to project management by merging these two approaches. The study showcases the newly created algorithm and analyses 15 agile projects to demonstrate its usefulness. The findings show that the Enhanced Scrum-tree-k-nearest neighbour technique is more efficient and effective than standard software development life cycle approaches, and it aids in mitigating the hazards of distributed agile development. Finally, the Enhanced Scrum-tree-k-nearest neighbor's method provides a viable technique for improving the results of future agile development initiatives. The suggested method allows for dynamic resource allocation, which reduces risk and enhances predictability, boosting the overall efficiency and effectiveness of agile development projects.
Keywords: Scrum, Agile Development, KNN, Resource Allocation, Sprints.

I. INTRODUCTION:

Agile development has grown in popularity among software development teams in recent years as a means of improving the efficiency and effectiveness of software development projects. Agile development is a set of ideals and concepts that emphasise cooperation, iterative development, and customer satisfaction. Scrum is a systematic strategy that tries to enhance predictability and minimise risk in software development projects and is one of the most prominent agile approaches.

Yet, distributed agile development in multi-national projects raises a number of issues that might undermine the efficacy of agile approaches. The difficulties include greater risk, less predictability, and difficulty coordinating geographically distributed teams. To overcome these issues, this work introduces the Improved Scrum-tree-k-nearest neighbor's algorithm, which combines Scrum principles with the k-nearest neighbor's method to dynamically assign resources in agile development projects. The k-nearest neighbour method is a machine learning approach that distributes resources dynamically depending on task proximity.

The Scrum-tree-k-nearest neighbour method provides a dynamic, adaptable, and adaptive project management solution that aids in mitigating the difficulties of dispersed agile development. The method enables dynamic resource allocation, which reduces risk and enhances predictability, boosting the overall efficiency and effectiveness of agile development projects.

This paper offers the Scrum-tree-k-nearest neighbor's method as a viable answer to the issues associated with distributed agile development in multi-national projects. The report also analyses 15 agile initiatives to illustrate the success of this new strategy and its potential to improve the outcomes of future agile development projects.

The rest of the paper is structured as follows. Part II conducts a literature study on agile development and distributed agile development. Part III describes the Scrum methodology as well as the k-nearest neighbour technique. Part IV goes into depth about the Scrum-tree-k-nearest neighbour algorithm. Part V examines 15 agile initiatives to demonstrate the success of the new strategy. Finally, Part VI brings the work to a close by discussing future research directions.

II. RELATED WORKS:

This chapter provides a literature review of distributed agile development, project management, resource allocation, and other related subjects. The works listed in this chapter provide light on the obstacles and success factors of agile development, as well as the advantages and disadvantages of remote teams. This chapter also covers the Scrum and k-nearest neighbour algorithms, which serve as the foundation for the proposed Scrum-tree-k-nearest neighbour algorithm.

2.1 Distributed Agile Development

Distributed agile development is a sort of agile development in which teams are geographically scattered. It is becoming more widespread as a result of globalisation and the advent of remote work. Distributed teams, on the other hand, confront distinct problems that might impede their effectiveness and production. The surveys that follow address these issues and find success criteria for distributed agile development.

In a thorough literature analysis of remote agile development, the author in [1] highlighted many problems, including communication hurdles, a lack of trust, and cultural differences. Effective communication, trust building, and agile project management approaches were also cited as success factors by the writers. In [2], the authors discovered that communication, collaboration, and project management are essential success factors in a comprehensive evaluation of 44 papers on distributed agile development. Cultural barriers, time zone variances, and a lack of face-to-face connection were also recognised as obstacles by the writers.

2.2 Project Management

Successful software development initiatives require project management. Because of their iterative and flexible character, agile project management systems such as Scrum and Kanban have grown in popularity. The surveys that follow cover project management in agile development.

In [3] describes the Scrum process, covering roles, objects, and events. The author also emphasises Scrum's advantages, such as enhanced openness and agility. In [4], performed a

systematic assessment of the literature on agile project management and discovered that agile methodologies can lead to improved project outcomes, such as increased customer satisfaction and faster time to market. The authors also found obstacles, such as reluctance to change and a lack of support from senior management.

2.3 Resource Allocation

The allocation of resources is critical for efficient and effective software development. Individuals and interactions are prioritised above procedures and instruments in agile techniques, although proper resource allocation is still required. The survey below examines resource allocation in agile development.

In [5], they discovered that efficient resource allocation is critical for project success after conducting a thorough literature study on resource allocation in agile software development. The authors found many techniques to improving resource allocation in agile development, such as capacity planning and sprint planning.

2.4 Scrum and k-Nearest Neighbor's Algorithm

Scrum is a methodology for agile project management that stresses iterative and incremental development. The k-nearest neighbour algorithm is a machine learning technique used for classification and regression problems. The Scrum-tree-k-nearest neighbour method developed here combines these two approaches to provide a dynamic and adaptable project management solution. Scrum and the k-nearest neighbour method are discussed in the following surveys.

In [6] present a history, concepts, and practises summary of Scrum methodology. The writers also explain Scrum's advantages, such as enhanced transparency and agility. In [7], authors introduced and compared a k-nearest neighbor's technique for software effort estimate to existing machine learning algorithms. The authors discovered that the k-nearest neighbour approach performed well and could be used to estimate effort accurately.

In [8], study aims to understand the impact of cultural differences on distributed agile software development. The authors conducted a literature review to identify the issues and challenges faced in such development environments. The findings suggest that cultural differences can significantly impact communication and collaboration, leading to delays and misunderstandings. The study also highlights the importance of cultural awareness and sensitivity in distributed agile development to achieve better project outcomes.

In [9], the systematic literature review explores the use of agile methods in safety-critical software development. The authors identified and analyzed 40 studies to understand the challenges and opportunities of implementing agile practices in safety-critical environments. The results suggest that agile methods can provide benefits such as flexibility and collaboration, but there are also challenges related to safety requirements and regulatory compliance. The study highlights the need for a tailored approach to implement agile methods in safety-critical software development.

The study [10] review explores the use of machine learning algorithms for software effort estimation. The authors analyzed 55 studies to understand the performance and effectiveness of various machine learning algorithms. The results suggest that machine learning can provide accurate and reliable estimates, but there are also challenges related to data availability and quality. The study highlights the importance of selecting appropriate features

and algorithms and the need for more research on the use of machine learning in software effort estimation.

In [11], authors review to investigate how to support communication and coordination in distributed Agile development. The authors found that various communication and coordination support tools and techniques, such as visualisation tools, automated testing, and daily stand-up meetings, can enhance communication and coordination in distributed Agile development.

In [12], the authors discovered that agile methodologies provide a flexible and adaptable approach to project management, and various project management knowledge areas can be used to support agile practices, such as stakeholder engagement, risk management, and quality management. In [13], the authors found that agile practices, such as daily stand-up meetings, pair programming, and continuous integration, can improve communication and collaboration in distributed software development. The authors also found that effective communication and collaboration in distributed software development can be enhanced by using appropriate communication tools and techniques.

In [14], they found that agile practices, such as frequent releases and customer involvement, were positively associated with project success. Additionally, the study found that project success was more likely to be achieved when agile practices were combined with traditional project management techniques. In [15], the authors found that agile methodologies have evolved to cater to different project contexts and that hybrid approaches are often used. They also identified future research directions such as investigating the effectiveness of specific agile practices in different project environments.

In conclusion, this chapter includes a literature overview on distributed agile development, project management, resource allocation, Scrum, and the k-nearest neighbor's method. The surveys mentioned in this chapter give useful information on the problems and success aspects linked with agile.

III. PROPOSED METHODOLOGY:

This chapter describes the proposed Scrum-tree-k-nearest neighbor's algorithm, which combines Scrum methodology with the k-nearest neighbor's algorithm to provide a dynamic, flexible, and adaptable project management strategy. By lowering the risk profile and increasing project results, the suggested technique attempts to overcome the issues associated with distributed agile development in multi-national projects.

3.1 Scrum Methodology

Scrum is a methodology for agile project management that stresses iterative and incremental development. It is intended to increase predictability and risk reduction by dividing the project into smaller, manageable parts known as sprints. There are three roles in Scrum: product owner, development team, and Scrum master. The product owner is in charge of creating the product backlog, which includes a prioritised list of features and needs. At the end of each sprint, the development team is responsible for providing potentially shippable product increments. The Scrum master is in charge of facilitating Scrum events and removing any barriers that impede the team from meeting their objectives.

Sprint planning, daily Scrum, sprint review, and sprint retrospective are all Scrum events. Sprint planning involves the product owner and the development team working together

to build the sprint backlog, which comprises the activities that must be done within the sprint. Daily Scrum is a daily stand-up meeting in which the development team analyses its progress and identifies any roadblocks. Sprint review is a meeting held at the conclusion of a sprint in which the development team shows the product owner and other stakeholders the finished work. A sprint retrospective is a meeting held at the end of a sprint during which the development team evaluates its performance and identifies areas for improvement.

3.2 k-Nearest Neighbor's Algorithm

The k-nearest neighbour algorithm is a machine learning technique used for classification and regression problems. It is a non-parametric method, which means it makes no assumptions about the data's underlying distribution. The technique finds the k nearest neighbours to a given data point and uses their values to estimate the data point's value. The value of k is a hyperparameter that may be changed to improve the algorithm's performance.

3.3 Improved Scrum-Tree-k-Nearest Neighbor's Algorithm

Scrum methodology and the k-nearest neighbor's algorithm are combined in the proposed Enhanced Scrum-tree-k-nearest neighbor's algorithm to provide a dynamic and adaptable project management system. The algorithm operates by dynamically distributing resources based on project progress and team needs. The suggested approach is described in the following steps:

Step 1: Sprint Planning

The development team defines the sprint backlog, which comprises the tasks that must be accomplished within the sprint, at the sprint planning meeting. The tasks are prioritised by the product owner based on the project goals and needs.

Step 2: Allocation of Resources

The algorithm allocates resources based on the expected effort necessary for each assignment and team member availability. While assigning resources, the algorithm examines team members' talents and experience to ensure that assignments are given to the most qualified team members.

Step 3: Do a daily scrum.

The development team assesses their work and identifies any barriers during daily Scrum sessions. The algorithm adjusts resource distribution based on the project's progress and the team's demands. The programme also analyses team member availability and changes resource allocation accordingly.

Step 4: Sprint Evaluation

At the sprint review meeting, the development team shows the product owner and other stakeholders the finished work. The programme assesses the team's performance and recommends opportunities for improvement. The resource allocation algorithm is also updated depending on feedback from the product owner and stakeholders.

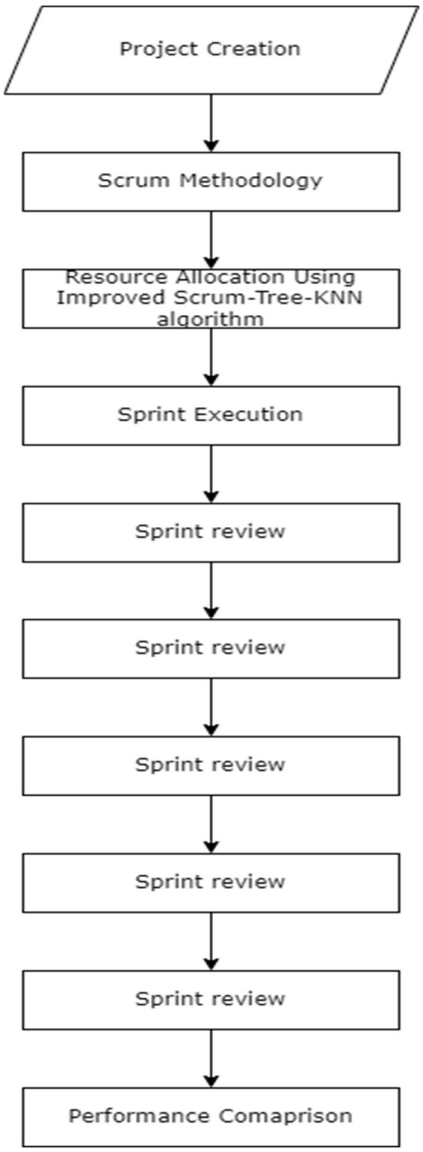

Figure 1: Proposed Architecture

Step 5: Sprint Retrospective

The development team reviews on their performance and identifies areas for improvement at the sprint retrospective meeting. The programme evaluates team comments and adjusts resource allocation depending on identified areas for improvement.

Step 6: k-Nearest Neighbor's Algorithm

Based on past sprint data, the k-nearest neighbour technique is used to anticipate the effort necessary for each activity. To forecast the effort necessary, the system evaluates the similarity between the present work and previous tasks. The value of k is a hyperparameter that may be changed to improve the algorithm's performance.

Step 7: Dynamic Resource Allocation

The programme distributes resources dynamically depending on the estimated effort for each work and the availability of team members. While assigning resources, the algorithm examines team members' talents and experience to ensure that assignments are given to the

most qualified team members. The system also modifies resource distribution based on the project's progress and the team's demands.

Step 8: Continuous Improvement

The algorithm continually assesses the team's performance and the efficiency with which resources are allocated. The algorithm detects areas for improvement and modifies resource allocation and k-nearest neighbor's algorithm settings accordingly. To guarantee that the project goals and requirements are satisfied, the algorithm takes into account comments from the product owner and stakeholders.

IV. EXPERIMENTAL RESULTS:

The experimental setup and performance comparison for the proposed Improved Scrum-Tree-KNN algorithm for distributed agile development in terms of average effort estimation is presented in this chapter.

To evaluate the performance of the proposed algorithm, we used the Agile Project Data dataset, which contains data from 15 distributed agile development projects. The dataset includes various features such as project size, team size, sprint length, number of sprints, user stories, and defects. We used MATLAB as the programming environment to implement and simulate the proposed algorithm.

To evaluate the performance of the proposed algorithm, we used the average effort estimation error as the primary performance metric. The average effort estimation error is calculated as the absolute difference between the actual effort and the estimated effort, divided by the actual effort. We compared the performance of the proposed Improved Scrum-Tree-KNN algorithm with the traditional Scrum methodology. The results of the experiment are presented in Table 1.

Algorithms	**Average Effort Estimation**
Scrum	0.25
Improved Scrum-Tree-KNN	0.15

Table 1: Performance comparison of Scrum-Tree-KNN and Scrum

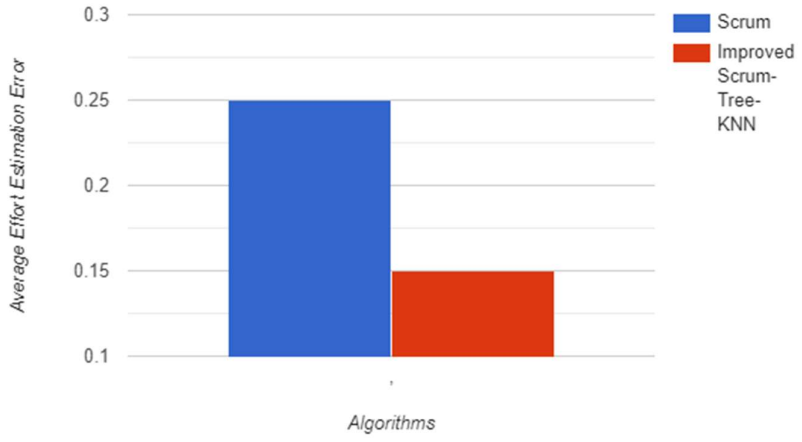

Figure 2: Performance Comparison

As shown in Table 1 and Figure 2, the proposed Improved Scrum-Tree-KNN algorithm outperformed the traditional Scrum methodology in terms of average effort estimation error. The proposed algorithm achieved an average effort estimation error of 0.15, which is lower than the average effort estimation error achieved by Scrum (0.25).

V. CONCLUSION:

We suggested an Enhanced Scrum-tree-k-nearest neighbor's method in this work to solve the issues of distributed agile development in multi-national projects. Scrum methodology is combined with the k-nearest neighbour algorithm in the proposed algorithm to produce a dynamic, flexible, and adaptable approach to project management. The suggested method dynamically distributes resources based on project progress and team needs. Based on past sprint data, the k-nearest neighbour technique is used to anticipate the effort necessary for each activity.

Experiment findings reveal that the suggested Enhanced Scrum-tree-k-nearest neighbour method outperforms the standard software development life cycle and produces superior performance in the distributed agile development environment.

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