

**AN APPROACH TO SUPPORT THE
SPECIFICATION OF AGILE ARTIFACTS IN
DEVELOPMENT OF SAFETY CRITICAL SYSTEM**

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Degree of

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DECLARATION STATEMENT

I hereby declare that the research work reported in the dissertation/dissertation proposal entitled “AN APPROACH TO SUPPORT THE SPECIFICATION OF AGILE ARTIFACTS IN DEVELOPMENT OF SAFETY CRITICAL SYSTEM ” in partial fulfillment of the requirement for the award of Degree for Master of Technology in Computer Science and Engineering at Lovely Professional University, Phagwara, Punjab is an authentic work carried out under supervision of my research supervisor Mrs. Ambica verma. I have not submitted this work elsewhere for any degree or diploma.

I understand that the work presented here with is in direct compliance with Lovely Professional University’s Policy on plagiarism, intellectual property rights, and highest standards of moral and ethical conduct. Therefore, to the best of my knowledge, the content of this dissertation represents authentic and honest research effort conducted, in its entirety, by me. I am fully responsible for the contents of my dissertation work.

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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the M.Tech Dissertation/dissertation proposal entitled **“AN APPROACH TO SUPPORT THE SPECIFICATION OF AGILE ARTIFACTS IN DEVELOPMENT OF SAFETY CRITICAL SYSTEM ”** submitted by **Gurmeet kaur** at **Lovely Professional University, Phagwara, India** is a bonafide record of his original work carried out under my supervision. This work has not been submitted elsewhere for any other degree.

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ABSTRACT

The software testing is the technique of software engineering to test the software faults. The various type of testing are there which are black box, white box, automatic, etc. the agile testing contains multiple testing which are applied on the software to detect maximum number of faults. The major issue of agile testing is to define exact sequence of the testing. In the base paper, the genetic algorithm is applied to define the sequence of testing. In the genetic algorithm the objective function is static. Due to which, its efficiency is less as compared to algorithm in which objective function is dynamic. In this research work, technique will be proposed which has dynamic objective function to define exact sequence of testing in agile testing.

1.1 Agile Testing

The testing phase of software development sometimes faces various issues with respect to the developers and IT managers involved. However, the quality of software can be determined only with the help of testing which also tells whether the application can perform properly or not. Within the Software Development Lifecycle (SDLC), the testing plays a very important role. There are various risks taken within the companies due to which the software might perform poorly if the testing strategy applied is not good. The software testing practice in which the principles of agile software development are followed is known as agile testing. The testing is integrated into development process with the help of agile development and not kept aside from the SDLC phase. A cross-functional agile team is included within the agile testing which depends on the special expertise that the testers provide. A “whole-team” mechanism is utilized in order to enhance the quality of the software product by the agile team. The team collaborates actively with the development team as the testing occurs within the real time. This results in identifying and transferring the issues into the specifications which are executable and protect the coding. The approval of the detailed design documents of development team is must before initializing the testing [1]. This can help in initiating the generation of test cases. Within the Sprints or Iterations, the coding as well as testing is performed in incremental and iterative manner. This helps in generating each feature until there is enough stability delivered. This results in improving the product’s quality.

The specifications of business are analyzed by the combined team that involves the development and testing phases. The Sprint goal is defined through the combination of these phases. The testing scope is defined by the QA team where the whole team as well as the client validates and approves it. The work is initiated on the test case design by the QA team while the implementation of modules is carried out by the development team. Either within the testing tool or in the Excel spreadsheet, the generated modules are documented in a proper way. In order to review this, the document is forwarded to the development team and project sponsor. It is ensured here that the test coverage is

completed to the utmost level. The testing is initiated on the QA environment by the QA team once the test case review and modification are covered. Within the defect tracking tool, the defects identified during testing are logged in a proper manner [2].

There are certain important elements present within the effective agile systems which are mentioned below:

- The testers and QA managers are included as the members within the agile development team.
- Within the planning and requirements analysis, the testers are included as active contributors.
- The importance of testers is promoted and the continuous sharing of feedback is encouraged with the help of programmers and the customer.
- The main business flows are defined with the help of testers which actively participate within the meeting.
- Along with the developers, the testers work on the short iteration activities.
- The traceability amongst the requirements, test cases and bugs is encouraged here.
- The story improvements of the user are encouraged by the testers [3].
- The specialized skills of test-driven development are leveraged which include unit testing, continuous integration as well as unit level.
- The regression testing is done with the automation testing.

1.1.1 Agile Testing Disadvantages and Mitigations

The best testing methodology is proved by agile testing only when the requirements of the user are very clear to the sponsors of project. The details are not clear if the overall requirements of the user are not clear. A path is taken on the basis of initial requirements for the new products in order to design the software architecture. The following conditions occur, if the requirements change with frequent time duration:

- As the significant effort has already been mentioned within the initial requirements development and testing process, the team struggles to adapt to the next changes.

- Within the estimations and sizing requirements, various challenges occur. As the QA is logically the last task for completing the story, it gets short shrift. Thus, the QA timelines get affected due to the delay in prior development task.
- A test case for the complete iteration is prevented from being executed by the QA which leaves the team to struggle in order to complete the tasks assigned.
- The right questions are not asked which is very harmful for the QA. There should be regular team meetings to avoid such kind of issue to arise in future.
- Within the current iteration, new user stories are added in which the QA also needs to be included. This will help in building up specific commitments and estimations and avoid any kinds of issues.

1.2 Test Plan for Agile

The test plan is written and updated to each of the release within the agile model which is not similar in case of waterfall model. The types of testing performed within a particular iteration are included within the agile test plan. The different types of test plans involved in agile are [4]:

- i. Testing Scope.
- ii. New functionalities which are being tested
- iii. Level or Types of testing based on the features complexity
- iv. Load and Performance Testing
- v. Infrastructure Consideration
- vi. Mitigation or Risks Plan
- vii. Resourcing
- viii. Deliverables and Milestones

1.3 Agile Testing Strategies

There are four different stages involved within the life cycle span of agile testing. These stages are explained below:

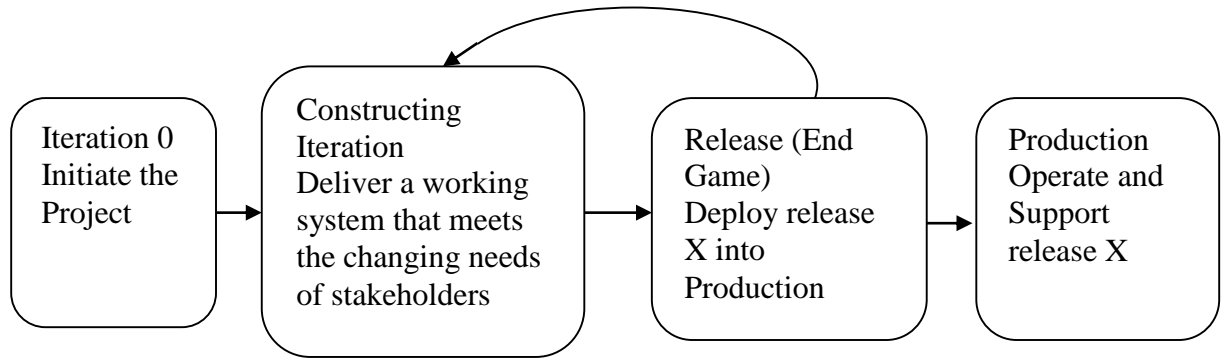


Fig. 1 Agile Testing Strategy

(a) Iteration 0

The initial setup tasks are performed within the initial stage or iteration 0. The people are recognized here in order to perform testing, to install the testing tools, schedule the resources and so on. In order to achieve Iteration 0, the following steps are followed [5]:

- a. A business case is established for the project.
- b. The project scope and boundary conditions are established.
- c. The key requirements are use cases which drive the design trade-offs are specified.
- d. One or more candidate architectures are outlined.
- e. The risk is identified here, if any.
- f. The estimated cost is presented and the preliminary project is prepared.

(b) Construction Iterations

The construction iteration is the secondary phase of testing in which the majority of testing is performed. In order to build an increment of the solution, a set of iterations are performed within this phase. A hybrid of practices is implemented by the team in order to do so. The prioritized requirement practice is followed by the agile team during construction iteration. The most important requirements which are remaining from the work item stack are gathered from each iteration here and then implemented. There are two classifications of the construction iteration which are confirmatory testing and investigative testing. A verification related to the fulfillment of intent of the stakeholders as described to the team to date is done within the confirmatory testing. The team

performs this type of testing [6]. The issues that are ignored by the confirmatory team are detected by the investigative testing. The potential problems are identified by the testers in the form of defect stories by the investigative testing. The common issues such as integration testing, load testing and security testing are handled within the investigative testing only. There are two aspects which are developer testing and agile acceptance testing within the confirmatory testing. In order to enable the continuous regression testing within complete lifecycle, both of these systems are automated. The agile that is equal to testing as per the requirement is involved within the confirmatory testing. The combination of traditional functional testing and traditional acceptance testing is known to be the agile acceptance testing. This is combined as the development team and stakeholders perform it together. The traditional unit testing and traditional service integration testing are combined together to form developer testing. The application code as well as the database scheme is verified by the developer testing.

(c) Release End Game Or Transition Phase

The system is deployed successfully into production with the help of an objective which is “Release, End Game”. The training of end users, support people and orientation people are the three phases that are included within the activities. The marketing of product release, back-up and restoration, finalization of system and user documentation are also involved within this method. Complete system testing and acceptance testing is involved within final testing stage. The product needs to be tested more frequently within its construction iterations for finishing the final testing stage without many problems. The testers will work on the defect stories identified at the end stage [7].

(d) Production

The product is forwarded to the production stage once it is dispatched from the release stage in this process.

1.4 Effective management of a Test project

Even before the testing is actually performed, any types of risks or errors are recognized when the effective planning techniques are implemented. A different mention is necessary even when the tasks are interrelated to each other.

1.4.1 Allocation and distribution of tasks

Within the planning stage, the effort estimation and sizing are included from which the need of these tasks is identified. There are some pointers used in order to allocate the tasks while keeping in check the size, schedule, properties and skills of the team. They include:

- i. Making the team members gathers around and communicating the objectives to the members is very beneficial. The particular task is specified in proper rationales to the members. A meaningful method for accomplishing the tasks is required when the fitting of work within the overall scheme of things is known. This will help in deriving a meaningful method to accomplish these tasks [8].
- ii. A skill cart of all the team members is prepared and the tasks are assigned to them accordingly. Even the junior team members are given a fair chance. For instance, in any case, there is a huge task given, the task can be divided amongst the senior and junior members of the team. The leadership qualities within the senior member can be enabled through this and will also improve the knowledge of a junior team member. More than one senior member can provide help if any task is highly complex and cannot be handled by one member.
- iii. The design after being successfully complete is forwarded to the complete team in order to receive a review. The motive and logic which is behind the assignment is explained here. The individual can be checked before finalizing the assignment whether they have any issues with it or they need any suggestions to make. The schedule is to be discussed in case there are any objections and the type of status report that is required from their end is also presented here. If there is any feedback given it also shows that the allocations are not satisfactory for the user. The opinions of individuals are to be discussed and their opinions are to be respected. The options for re-balancing the assignment are also checked if the concerns expressed are valid. This helps in ensuring that the task will be completed on time and there will be no risk.
- iv. The mode of reporting which is expected is to be agreed here. Any kind of mode which the user is comfortable with is to be selected here. The user must feel free to share any kinds of issues arising and the team must help them is solving those issues so that the goal can be achieved.

- v. The required tasks are tracked by identifying the required tools. The tasks that are not yet worked upon can be reviewed after few time durations here along with the tasks that are in progress and the ones that have been achieved successfully.

1.5 The Agile Testing Quadrants

The complete process is divided into four quadrants which are known as the agile testing quadrants. This helps in understanding the manner in which the agile testing can be performed [9].

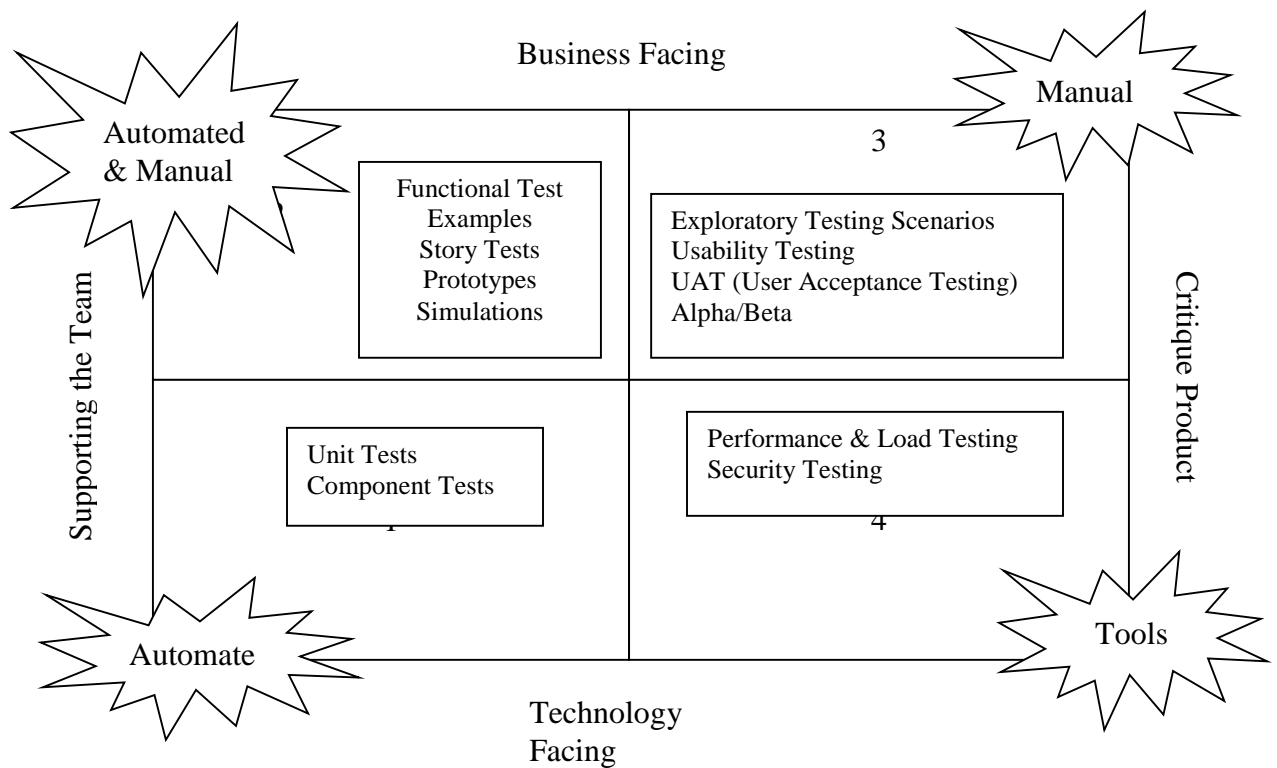


Fig. 2 Quadrants of Agile Testing

a) Agile Quadrant I: The major focus of this quadrant is on the internal code quality. There are various technology driven test cases involved here which are implemented to support the team. They are:

- Unit Tests
- Component Tests

b) Agile Quadrant II: The test cases which are business driven are involved within this quadrant. They support the team and help in focusing on the requirements involved. The various types of tests performed within this phase are [10]:

- The examples of possible scenarios and workflows are tested.
- The user experience such as prototypes is tested.
- Pair testing.

c) Agile Quadrant III: The feedback of quadrants one and two are provided by this quadrant. In order to perform the automation testing, test cases can be utilized here as the base. Various rounds of iteration reviews are carried out in this quadrant which helps in building confidence within the product being designed. The different types of testing performed in this quadrant are:

- Usability Testing
- Exploratory Testing
- Pair testing with customers
- Collaborative testing
- User acceptance testing

d) Agile Quadrant IV: The non-functional requirements such as performance, security, and so on are handled within this quadrant. The non-functional qualities and the expected value is delivered by the application through this quadrant.

- Non-functional tests for ex- stress and performance testing.
- Security testing on the basis of authentication and hacking.
- Infrastructure testing
- Data migration testing
- Scalability testing
- Load testing

1.6 QA challenges with agile software development

There are various challenges being faced during the development of agile software. Some of these challenges are [11]:

- In agile, the possibilities of occurrence of an error are more as there is less priority given to the documentation and high pressure is imposed on the QA team.
- There is an introduction of novel features which help in minimizing the available time for the test teams which helps in recognizing whether the recently added features match the requirement or not and do they address the business suits or not.
- A semi-developer role is played with the help of testers.
- There is a huge compression of test execution cycles.
- The test plan is prepared in very less time.
- Minimal timing is provided for regression testing.
- The roles are changed here as being the partner in quality rather than being a gate-keeper.
- Within the agile method, the requirement changes and updates are inherent which a huge concern for the QA team is.

1.7 Risk of Automation in Agile Process

There are various risks that arise within the automation process of agile testing. The list below mentions some of these risks [12]:

- A high level of confidence is provided by the automated UI which is however slow to be executed, fragile in order of maintenance and very costly. Unless the testers know the complete procedure of testing, the automation might not be able to enhance the test productivity.
- Within automated testing, unreliable tests are very important to be considered. It should be on higher priority to fix the failing tests and resolve the problems relevant to the brittle tests. This avoids false positives within the system.
- There is a risk of irregular running of the tests if the automated test is initiated manually and not through CI. This results in failing of tests as well.
- For an exploratory manual testing, the automated tests cannot be replaced. A mixture of testing types and levels is needed for acquiring the expected quality of the product.

- There are many simple features provided by various commercially available automation tools. The manual test cases are also required to be replayed here.
- The test failure occurs when the automation test plan is poorly planned or unplanned for saving the time.
- While performing manual testing, there are various test set up and tear down procedures which are missed out during test automation which make is seamless to test the set up and tear down procedures [13].
- The testing solutions which need huge maintenance in relation to the value provided are proposed and delivered by automation.

Chapter 2

LITERATURE REVIEW

Swadha Gupta et.al (2017) presented in this paper that there are still various applications in which the method of agile are not appropriately applied in order to compute complex software projects involved within them. The Agile manifesto is applied along with Agile Software Development in order to provide quick modifications. This also helps in providing appropriate changes which is very difficult here in comparison to the traditional approaches that were generated previously for providing the development of these systems. The changes that have occurred and have been observed during the implementation are presented in this paper. There is a detailed explanation provided here related to the important factors which affect the quality of agile. On the basis of large complex projects and technologies that require change of complex coding, testing, and communication tools and so on, the recommendations for the implementation depend. This will step towards the success of agile adaptation on large products in order to develop the software [14].

Manuel Acosta, et.al (2017) proposed in this paper a robust virtual sensor that uses a type-model-less approach for estimating the chassis planar motion stated and tyre forces during agile manoeuvres. The standard sensors signals present on the CAN bus of modern vehicles are gathered by virtual sensing that is gathered by the modular filter architecture which is designed of Stochastic Kalman Filters. An adaptive Neuro-Fuzzy Inference System is integrated within the virtual sensor structure due to the reason that the drift equilibrium relies on the tyre-road friction. This helps in providing a continuous approximation of the road friction properties or features present within the rigid as well as loose surfaces. The advanced vehicle controllers can possibly be designed with the help of tyre model. There will be an acceleration of development of time required specifically within the road applications. Further, the need to estimate the tyre properties online is also not required here. All such enhancements help in providing improvement in the traditional approaches and provide a better system which can perform better testing in terms of various aspects [15].

James B. Dabney, et.al (2017) investigated in this paper the previous techniques of agile testing involved. Further, the various enhancements required within particular techniques is also identified along with the utilization of agile frameworks for accommodating the development of huge systems. This paper also studies the compatibility of standard IV and V techniques in the hybrid agile development systems. It is found here that there are three groups amongst which the IV and V methods of hybrid agile process can be employed. They are early lifecycle IV and V techniques which are highly compatible to the hybrid lifecycles involved. The second is the IV and V techniques that completely depend on tracing the needs, test objectives, etc which are incompatible to some extent but can be modified as per the need and converted into being compatible as per the needs. An assessment is need within the IV and V techniques that can provide complete artifact which is simple in comparison to the hybrid agile processed. All such investigations and modifications proposed in this paper help in making enhanced testing systems and provide better results [16].

Khush Bakhat Awar, et.al (2017) presented in this paper that there are numerous issues being faced by the distributed teams when they utilize agile systems within their environment. The local software industry has not been able to provide much help regarding these issues being faced. The growing trend has been within the agile and distributed software development in the market lately. When the agile and distributed software development combines together, there are many problems that arise. The agile practices which are utilized by the distributed teams can be recognized and can be provided with better quality. The agile practices which are utilized by the distributed systems are studied in detail and are presented within the latest studies as well. An empirical based investigation is proposed in this paper which provides a detailed study related to the important factors present within the agile distribution method. A theoretical model related to the particular agile alignment practices is presented here which helps in mitigating the distributed agile software development process. The important factors of the distributed agile environment are presented in the model stated within this paper. In order to test the applicability of the proposed model, the concept of case study was proposed within the experiments. Further studies relied on the results achieved from the

proposed work. The Scrum and XP methods were tailored in order to apply the agile practices within the distributed scenarios in better way and to avoid various issues [17].

Narjes T. Jahromi, et.al (2017) presented in this paper that there is a need to provision the value-added video services as there is a huge growth in demand of these services from the users end. Within the content delivery networks (CDNs) a cost-efficient and agile technique is to be presented which might help in providing enhancement in the previous existing approaches. An emerging technique that has an objective of minimizing the costs and bringing the agility by decoupling network functions is done with the help of Network Function Virtualization (NFV). The network functions are decoupled from the present hardware systems here. This is not utilized alone in all the scenarios and is included with Software Defined Network (SDN) in order to provide enhancements. SDN is basically a technology that decouples the control and data planes of the network. An NFV and SDN-based architecture is proposed in this paper in order to provide cost-efficient and agile provisioning of value-added video services. The value-added video services are enabled within the Virtual Network Functions (VNFs) within the proposed architecture. Further they are linked together with the help of application-level SDN switches. In order to generate the implementation architecture, the HTTP technology is utilized. A prototype is built here and deployed within the OPNFV test lap. The performance is evaluated here in terms of various aspects and it is seen that there is huge improvement within these systems to provide enhanced mechanisms for testing [18].

Olivier Liechti, et.al (2017) presented in this paper that the important aspects of agile methods involve continuous improvement, feedback mechanisms and the automated testing. There are three practices involved within the test analytics which are presented here. The concept is explained here with the industrial case study and the experiments are conducted by the team. A goal or objective is set here in order to provide testing which are much better the existing approaches. The manner in which the mindset of the requirements is changes is explained here within these experiments along with manner in which the team members behave. An open source test analytics platform is presented here which helps in sharing the positive learning with the community it surrounds. The features and architecture of the system are explained in this paper which helps in utilizing this system in better way. Within the broader context of software analytics, the test

analytics needs to fit. A simple and effective manner is presented in this paper which helps in visualizing the progress achieved by the team. In order to initiate the test analytics platform there are numerous experiments conducted [19].

Ying-Dong Pi, et.al (2017) presented in this paper that the combined conventional method might not perform good in terms of accuracy within the agile optical satellite applications. This might be mainly due to the issues arising in the geometric accuracy of the reference data and the matching accuracy amongst the images present amongst various sensors. A cross-image pair (CIP) method is proposed in this paper which is highly mobile within the AOS. This includes a push-broom image and a swing scanning image for similar types of area. A novel calibration method is proposed in this paper for an AOS that is characterized with the help of constraints from the CIP instead of reference images that cover the calibration site in the system. A charge-coupled device detector is fitted here by two polynomials within the viewing angle that introduces a rigorous imaging model for establishing the calibration model. Huge adjustment is proposed here within the constraint for digital surface model (DSM) is utilized. This helps in solving the unstable computation stemming from the strong correlation amongst ht numerous parameters provided within the images. Various experiments were conducted in this paper using CIP simulated which helped in determining the performance of imaging process of AOS. Huge improvement is achieved here in terms of accuracy [20].

Ted J. Steiner, et.al (2017) proposed in this paper the smoothing and mapping with Inertial State Estimation (SAMWISE) navigation system which is a vision-aided inertial navigation system. It helps in providing high-rate, low latency state for enabling the high dynamic flight. A flexible framework is provided by SAMWISE in order to provide the inertial navigation system with the help of non-linear measurements. It provides the visual feature trackers and uses the incremental smoother for optimizing the set of non-linear measurement constraints. This helps in estimating the vehicle trajectory within the sliding window which might also include very less delay. Various experiments are conducted here in order to determine the performance of proposed system. During the DARPA Fast Lightweight Autonomy (FLA) program, the experiments were conducted which helped in showing the improvements. It is seen that the proposed navigation

system provides robust mechanism during the high speed across the multiple distinct scenarios in various aspects [21].

Ka Wai Wong, et.al (2017) proposed in this paper a tunable bandstop filter (BSF) in which the barium strontium titanate (BST) varactors are utilized for providing a proper tuning range. There is a bandwidth and rejection level of improvement within the systems with the application of filter within this device. Asynchronous biases are applied in order to enhance the performance of the filter. This results in enhancing the various parameters of the proposed system. It is seen through various experiments that the third-order input intercept point is exhibited by the filter which is higher than 40dBm. There is a wideband phase inverter also utilized here which helps in generating various design guidelines. The re-configurability of the system is presented here within the frequency of agile applications in order to provide various enhancements. It is seen that the performance of the system is improved along with various other modifications [22].

Chapter 3

SCOPE OF STUDY

The agile testing is testing technique in which multiple type of testing's are involved. These testing's are white box testing, black box testing etc . These testing' s are performed at each and every stage of the project development . The agile testing can be performed to increase efficiency of software testing. The problem which exists in the testing is of scheduling. The scheduling means type of testing which can be applied on each stage. It means that on which stage white box testing applied on which stage black box testing is applied. In the base paper, no counter measure parameter has been defined which can schedule the different- different testing on different-different stages. When the testing is not properly scheduled, efficiency of agile testing can be reduced. In this work, enhancement in agile testing will be proposed for scheduling different type of testing to test system software.

Chapter 4

OBJECTIVES OF STUDY

1. To study and analyze various agile testing techniques for software testing.
2. To propose enhancement in agile testing for scheduling different type of testing in system software.
3. The proposed enhancement will be based on technique of neural networks to schedule different type of testing's.
4. To implement proposed and existing technique of agile testing and compare results graphically in terms of error detection.

The technique of job scheduler will be applied in which the white and black box testing will be applied according to scheduling. As agile testing consists of all type of testing and these testing methods are classified as white box and black box. The testing which you applying will be scheduled and errors are detected from the software. To implement the project, case study of online shopping website will be considered. In this case study various modules of the website are considered and their test cases. The agile testing will be applied on each module of the website with their developed modules. This will help out to detect maximum number of errors or bugs from the project.

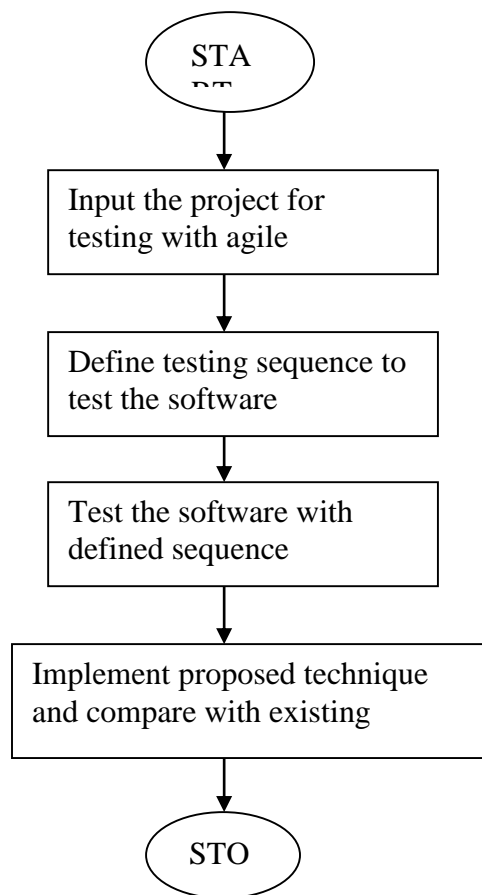


Fig 3:- Proposed Flowchart

EXPECTED OUTCOMES

Following are the various expected outcomes of this research:

1. The proposed improvement can generate proper sequencing of testing in agile testing. This will increase fault detection rate.
2. The correct sequence of testing in agile testing can reduce execution time of fault prediction.

Chapter 7

SUMMARY AND CONCLUSION

In this work, it has been concluded that agile testing is the efficient technique to detect maximum number of faults from the software. The agile testing consists of various other types of testing like black box, white box, automation and so on. The major challenge of agile testing is to define exact testing sequence. In this work, the algorithm which has dynamic objective function will be proposed to define testing sequence. The proposed improvement leads to increase fault detection rate and reduce execution time.

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