Identification of Minimum Software Process Development Activities for Development of Categories of Software: An Efficient and Effective Approach

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Software Engineering mainly deals with processes to ensure delivery of software product through systematic control of software development process activities. It enforces an engineering discipline to achieve the basic purpose of software through a development methodology. Process model usually consists of activities which are the part of software development process, software product and the role and responsibilities of people involved in software engineering. Not all the activities are necessary for all the type of application software. Since all the activities are not required, we can study the actual requirement in various types of application software. Various types of application software such study would be very useful for faster software development thereby eliminating unnecessary activities in each phase of software development process. The results of studies will be a set of minimum activities for each type of application software that are necessary for the development of good quality software. The application software may be soft computing software, financial software, artificial intelligence software, business software and so on. Our work does not aim to focus on agile engineering which eliminates documentation but we want to scientifically study towards minimization of process activities. We shall be taking number of software development tasks and perform estimation and for full and minimized process model and see the actual results against estimations. Some tasks for simulation of process model shall also be performed.

Keywords: Software Process Improvement (SPI), Software Development process (SDP) ,Soft computing, process activities, Artificial Intelligence (AI), Artificial Neural Networks (ANN)

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1. Introduction

Software is set of instruction to take inputs and to process them to produce the intended output. It also consists of a set of documents or manual for example, user manual, meant for users to understand the software system. Further, software comprises the source code, design documents, operation manual, installation manuals etc. software which is made or developed for specific requirement is known as software product. The software development process is used for good quality product in software industries. There are various types of software products some of which are generic and other may be customized.

1) Generic Product: The software product which can be used by any user and sold on the open market to any customer.

2) Specific Product: The software product developed for specific requirement stated by the customer for specific purpose.

There are many good features of well engineered software product some which fulfillment of functional requirements are efficiency, maintainability, dependability, adaptability etc.
Software engineering is evolving rapidly and various tools and technologies are constantly being improved for aid in rapid development of software. By implementing the principles of software engineering the software developers can create high quality, reliable and maintainable software product that meets the user needs. The software engineering principles also ensures that the developed software product is correct, consistent and within budget. Many software projects fail due to inconsistency, delays, and extremely high cost. There are several other important causes of software project failure. Conducting too many activities requires high cost and time.

Further, the software development process can be seen as the collection of four major phases namely specification, development, validation, evolution. The specification phase includes all the activities. From which the user requirements are collected and specified using requirement engineering. It must clarify the requirements of the software system like budget, time etc. The development of software such as coding, program etc is done here. During the validation phase the functionalities and other aspects are reviewed to ensure correctness. In the evolution, it may be required to add new functionalities to existing system and hence it is required to be updated as per the needs.

The product and process in software engineering discipline are two crucial terms. To be precise, process is set of phases or step which consists of activities for product development and product is the final outcome of the development process. The main objective of the development process is the development of final software product according to the specified requirements.

Now, that we have understood the meaning of software product and the development process, it becomes necessary to discuss the types of software. Broadly there are two types of software namely system software and application software. System Software is mainly developed for management of interactions among application software, hardware and user. Application software is mainly used for specific application areas. The examples of application software are business software, financial software, inventory system, information systems and so on.

Types of application software are discussed here:

1) AI software: These software are developed using the simulation of human intelligence processes by machines, specially computer systems. Example of such software is expert systems, natural language processing and many more.
2) Fuzzy logic based software system: These software are based on the concepts of fuzzy logic. Applications are altitude control of spacecraft, satellite altitude control etc.

3) Neural network applications: It is mainly a series of algorithms that seeks to identify relationships in a data set via a process that mimics how the human brain learns. These software are extensively used in AI software applications as one of its branch.
4) Database software: A database is collection of interrelated data in a systematic way. These software helps in storage of data in the form of tables with insertion, deletion, update etc facilities.
5) An information system (IS) is an interconnected set of components used to collect, store, process and transmit data and digital information. Basically, it is a collection of hardware, software, data, people and processes that work together to transform raw data into useful information. It could be in business, college, hospital, charitable organization etc.
6) Financial software: This type of software is required for proper use by business organization for managing financial activity.
7) Inventory software: This system is used to track stock and supplies and sales through and entire supply chain.

2. Literature Review

In this paper [1], a cloud software life cycle has been proposed and verification also been done to handle the drawback of existing cloud software process models. The model which is proposed here is cyclic as well as iterative. The proposed model is compatible with level two and three of the capability maturity model integration. Model Is intended to help small enterprises to develop quality and to sustain such software at a affordable cost. The model also balances the requirement to produce good quality software processes in a pre-planned way. This CSCLP model suits to SMESs which is achieved by using some processes areas of second and third level of capability maturity model integration.

It also elaborates what to do to achieve this goal. The suggested future work is security process area which is critical because security and privacy issue faces more threats in such distributed cloud environments. More efforts and study is required in the field of research in security and privacy. Risk management process area is also required to be explored.

In this paper [2], the author has done systematic literature review for software process simulation modeling. The purpose is identification of trends and directions for future research on software process simulation and modeling. This review summerizes that agent based simulation and system dynamic paradigm is increasing and decreasing respectively. Basically, defining software process models is a mechanism that allows the abstraction of procedures, methodologies or set of activities in any area of software engineering. In most of real environments, the implementation of process model may become costly and complex tasks due to characteristics of software processes.

In this paper[3], the author attempted to obtain broader insights into the software process improvement practices and they have conducted survey targeted at software developers in New England. They collected 67 responses and used descriptive statistics to analyze the survey results. They also examined the impact of SPI methodologies on quality factors for software developers. To determine the degree of correlation between the two, spearman correlation coefficient was used.

In this paper [4], the author studied each development process models for different factors and parameters which are precisely included so that researchers could easily choose a process model based on the needed resources and expertise. They also analyzed the advantages and disadvantages of each process development models.

In this paper [5], the author presented the comprehensive review of various software model beginning with traditional software process model to agile process model used very often now a days. The assessment of various frequently used software model is done with metrics. Case studies also been

discussed to assess the software project measure such as duration staff size, budget, duration etc. The author also discussed co-existence of traditional and agile methods. The goal of each model is to achieve good quality software development.

Most of the literature is about process model and their improvement; estimations, but nothing has been talked about the work under study except one for cloud computing [1].

3. Methodology

Following full process is time consuming and costly. Purpose of research would be to benefit smart software development with low cost, essential functionalities, minimum required quality and adhering to customer agreed time frame. These investigations will help industry, academia and research by identifying minimum set of activities which can provide the above mentioned results.

The existing software process model still can be improved and modified towards being o less costly and highly efficient. Our method consist of following activities.

1. To classify these activities under: Basic/essential, more than essential, beyond essential. To propose a thin form of software process model for each of the development area.

2. To propose a thin form of software process model for each of the development area.

Simulation helps assess solutions to real situations in a software simulated environment, giving the opportunity to know the consequences-outputs-performance within a risk-free environment. Here real life situation could be area of software development. Mathematical modeling and parameter value identifications for a desired output are the main work areas of this.

This works is more focused on conventional software process models and less on agile models which are already established.

4. Categories of Software Under Study in Detail

Following software types will be applied with the research methodology for obtaining results:

4.1 AI-Artificial Intelligence

it is the science and engineering of making intelligent machinery-machinery with cognitive abilities, we make intelligent programs.

AI is of two types: As shown below in figure 1

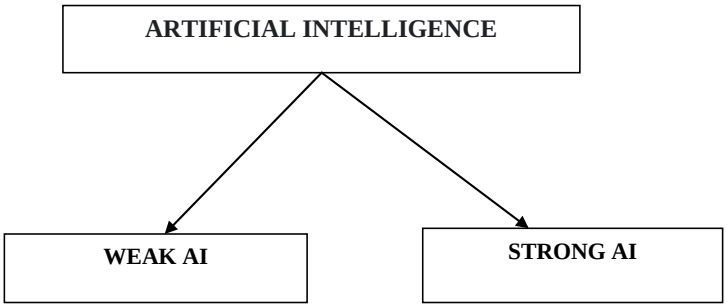

Figure 1 : Classification of AI

4.1.1 Weak AI: Here, machinery are imparted intelligence to do specific tasks. It is mostly used. Narrow is a better word for this type.

Examples of such applications are apple's siri, Amazon's Alexa, IBM Watson and Autonomous Vehicles.

4.1.2 Strong AI: It is made up of general and super intelligence.

Artificial General Intelligence: Here, machines have equal intelligence to humans.
Artificial Super Intelligence: here, machines would surpass the intelligence and abilities of human brain. Strong AI is theoretical with not many examples.
So, for our research, weak AI would be more applicable.AI has applications in virtual perception, speech recognition, decision making and NLP.

4.2 Deep Learning Versus Machine Learning

deep learning is neural network based with no human intervention. It uses feature extraction and large data sets. Machine leaning is dependent on human intervention to learn.

Machine learning has applications in

- Speech recognition
- Fraud detection
- Medical diagnosis

Machine learning does not require explicit programming. It is used for predictions and decision making.

4.3 Artificial Neural Networks

They are based on brain neurons models. Different applications of ANN are shown figure 2.

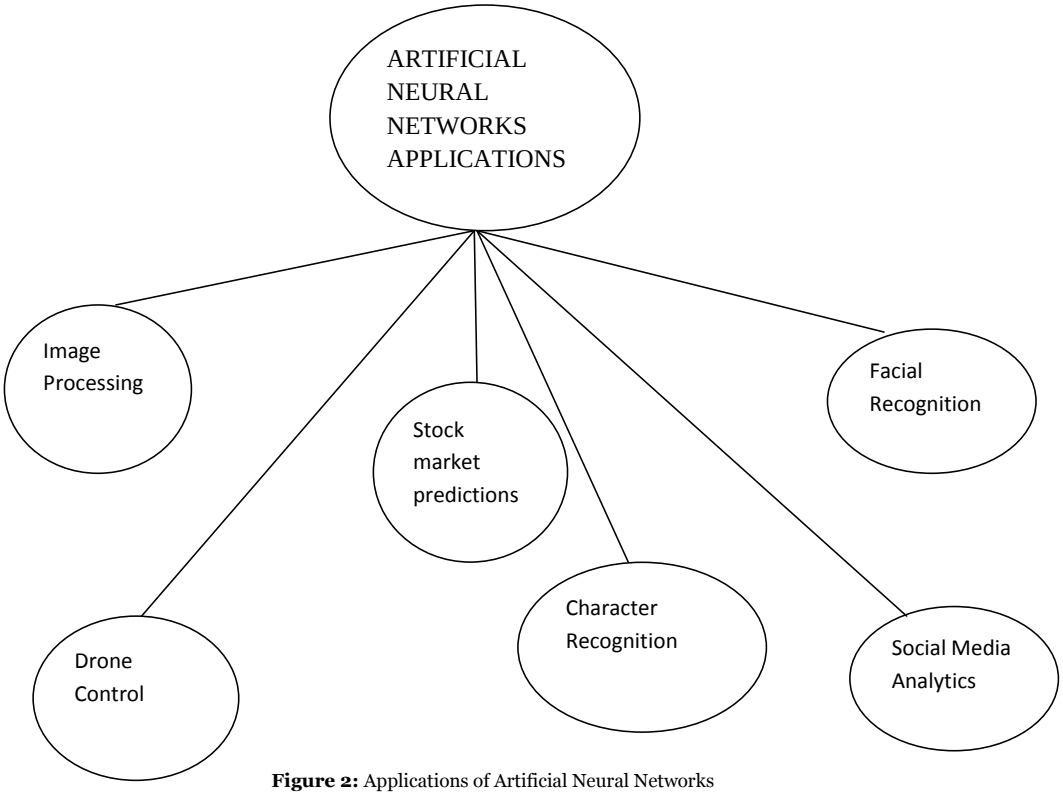

Figure 2: Applications of Artificial Neural Networks

Few other application areas and applications are:

Aerospace:

- Development of aircraft
- Fault diagnosis
- High performance piloting
- Modeling key dynamics

Defense: Neural networks are used in logistics, armed attack analysis, object location, air patrols, marine patrols, drone control.

4.4 Fuzzy Systems

Fuzzy logic represents number between 0 and 1. These software systems are useful in following application areas as shown in figure 2.

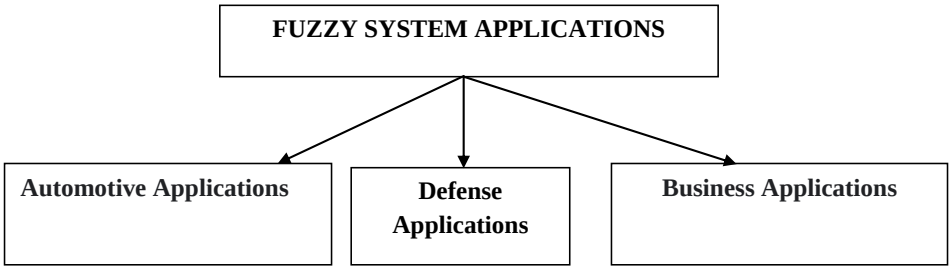

Figure 2: Fuzzy Logic Based Systems

Automotive applications:

- Speed control
- Intelligent highway system
- Traffic control
- Automatic transmission efficiency improvement

Business:

- Decision making system
- Personnel evaluation in a large company

5. Expected Outcomes

- Thin software process models for different types of s/w comprising of minimum activities keeping in mind the time of development and cost.
- Methods and procedure to identify minimum activities per phase per process model.
- Utilizable process models for learning and industry.

6. Applications of Research Findings

Less cost and time to develop different types of software.

This research will be useful for academia, industry and producing good software for society.

7. Conclusion

This research work considers different process models and activities under them. In industry, for each type of software it is not important to conduct each and every activity. Our aim is to diminish the set of activities to minimum so that cost and time can be saved and desired quality can be achieved. This work can be taken up for different types of software, such as- soft computing applications; fintech software; agritech software; business analytics applications; AI- artificial intelligence software; machine software. We expect different results for each category of software through this method of research so as to cater different IT industrial applications and respective research works. The review of literature shortfalls and proposed method is presented in this paper.

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