ANALYSIS OF MOBILE AGENT MEASURES WITH QUALITY FACTORS

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ABSTRACT

Mobile agent is intelligent, autonomous, ragged, interactive, coordinative, cooperative and proactive agents. There arise a lot many problems while moving the data, so to resolve such hindrances mobile agent move itself instead of moving the data. They are aspired to act smart and efficiently as they are acting on someone's behalf. Metrics measures have proven itself as great boon to judge a system's complexity, reliability and efficiency. Main objective of this paper is to keenly check mobile agent measures in regard with quality factors. The paper also analyse and evaluate some of the mobile agent measures and their effect on quality factors, as the quality factors are used to test a system's excellence.

Keywords: *Mobile Agent, Performance Measures, Quality Factor.*

I. INTRODUCTION

Agent oriented software engineering is a new technology which is still under construction and analysis. This technology completely gives a new rise/idea to software development industry. In this approach agents will be created which is not a physical entity but an autonomous, intelligent, reactive, social able and proactive entity. The most promising feature of agent is mobility, which here, means that the agent is migrating autonomously with in network on behalf of user [1].

Mobile agents are specialized agents which eliminates the necessity to move data from one system to another. This is so, because people wish to transfer data from server to client and vice versa, as earlier there was a huge security risk and integrity hindrances in previous techniques. So as to reduce the traffic and security risk, Mobile Agent paradigm brings the requesting client closer to the source and plays an vital role in network bandwidth reduction. Its characteristics are intelligent, autonomous, ragged, interactive, coordinative, cooperative and proactive [2,3]. Mobile agents have not yet been well received by the internet community [4] since issues such as reliability and security are yet receive developer's confidence. However, along with the wide spread of java-based applications, mobile agents have become extensively popular not only in the research community but also in industrial projects [5]. Metrics are measuring tools which are used to test and evaluate system abilities. Few metrics have been proposed for mobile agent, which can be used to measure the performance of mobile agent [6]. These metrics were based on various functions of mobile agent such as migration, cloning, saving its state and message passing .The measures are proposed to measure the complexity and performance of the system [7,8]. Quality means meeting the user requirements with a high degree of excellence. To test quality of a system we must evaluate its various factors like efficiency, portability, reliability, usability, security and maintainability [9]. The emergence of mobile agent frameworks has led many researchers to examine the quality factors of mobile agent measures. And in lieu with this we have shown interest in this promising area. All our efforts done

in regard with this paper, helps to configure out the enormous quality factors of mobile agent's measures and proportionately gives a slight contribution to mobile agent paradigm.

The paper is structured as follows. The section 2 discussed about definition and derived formulas of mobile agent performance measures. Section 3 provides various quality factors and design of quality model. The section 4 includes analysis of performance measures with the help of plot representation. At Last section 5 includes some concluding remarks and discusses future work.

II. MEASURES OF MOBILE AGENT

2.1 Number of Mobile Agent (NMA)

A multi agent system may have more than one mobile agent that is able to move itself in environment and other environments by preserving its internal states. To achieve a central goal of a multi agent system many sub goals are required, for this reason the system may require more than one mobile agent. This measure may be defined as the total number of Mobile Agents created in a multi agent system. This measure indicates how large a mobile agent system is.

NMA = Total Number of Mobile Agent Created.

Where, NMA is the total number of mobile agents [6].

2.2 Clone Life Time(CLT)

If a system has some kind of security issues then cloning of mobile agents will help in decreasing related risks, by not moving the mobile agent itself and move its clone everywhere outside the system, here clone will execute and transit in network. More than one clone may be created. This measure will help in measuring mobile agent lifespan with cloning. CLT can be defined as the total time taken by a clone after initiation, visiting locations, transition and reporting followed by termination.

$$CLT = t_v + t_t + t_r$$

Where, t_v is time consumed in visiting location

t_t is the time utilized in transition and

t_r is the time required in reporting back [6].

2.3 Mobile Agent Size (MAS)

Mobile agents are programs that run by moving itself across the systems to access the data, if the data size is greater than mobile agent size only then mobile agents are advantageous, hence this measure plays an important role in deciding whether to use mobile code or not. This measure can be defined as the total number of executable statements in a mobile agent program.

MAS= Number of executable statements of a mobile agent

Where, MAS is Mobile Agent Size [6].

2.4 Location Search Time (LST)

Number of hosts may presents in a environment and mobile agent will visit to these location for task completion but MA should select one of them and selecting one of them which is most suitable is location searching.

This measure can be defined as the time taken by a mobile agent in searching a required location among available locations.

LST = Time required to visit the favorable location.

Where LST is the Location Search Time [6].

2.5 Agent Location Visited Factor (ALVF)

It is defined as the ratio of number of locations visited by an agent during its lifetime to total number of locations.

$$ALVF = \frac{Number\ of\ Locations\ visited(LV)}{Total\ number\ of\ locations\ (TL)}$$

Where ALVF is the Agent Location Visited Factor [7].

2.6 Agent Clone Created (ACC)

This metric counts the number of clone created by an agent during its lifetime. It is defined as sum of clones of agents to the total number of agents.

$$ACC = \frac{\sum_{i=1}^{n} f_i}{n}$$

Where, n is the total number of Mobile Agents

and f_i is the number of clones of ith agent [7].

2.7 Messages Served by Agent (MSA)

This metric measures the messages served by an agent in response to another agents those are requesting services from the agent.

It is defined as ratio of number of messages served to total number of messages received.

$$MSA = \frac{MS}{TRM}$$

Where, MS is the number of messages served

TRM is total number of messages received [7].

2.8 Messages Rejected by Agent (MRA)

It is defined as ratio of number of rejected messages to total number of messages received.

$$MRA = \frac{TRM - MS}{TRM}$$

Where, MS is the number of messages served

TRM is total number of messages received [7].

III. QUALITY FACTORS

The factors that affect the software quality can be categorized in two main groups: Factors that can be directly measured and factors that can be measured only indirectly. In each case measurement must occur. ISO/IEC 9126 Provide the following description for quality characteristics/ factors [9]:

3.1 Functionality

It is defined as the capability of the software product to provide functions which meet stated and implied needs when the software is used under specified conditions. Sub characteristics are suitability, accuracy, interoperability and security.

3.2 Reliability

It is defined as the capability of the software product to maintain a specified level of performance when used under specified conditions. Sub characteristics are maturity, fault tolerance, recoverability.

3.3 Usability

It is defined as the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions. Sub characteristics are understandability, learn ability, operability, attractiveness.

3.4 Efficiency

It is defined as the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions. Sub characteristics are time behaviour and resource utilization.

3.5 Maintainability

It is defined as the capability of the software product to be modified. Modifications may include corrections, improvements, or adaptation of the software to changes in environment, and in requirements and functional specifications. Sub characteristics are analyzability, changeability, stability and testability.

3.6 Portability

It is defined as the capability of the software product to be transferred from one environment to another. Sub characteristics are adaptability, install ability, replace ability and coexistence.
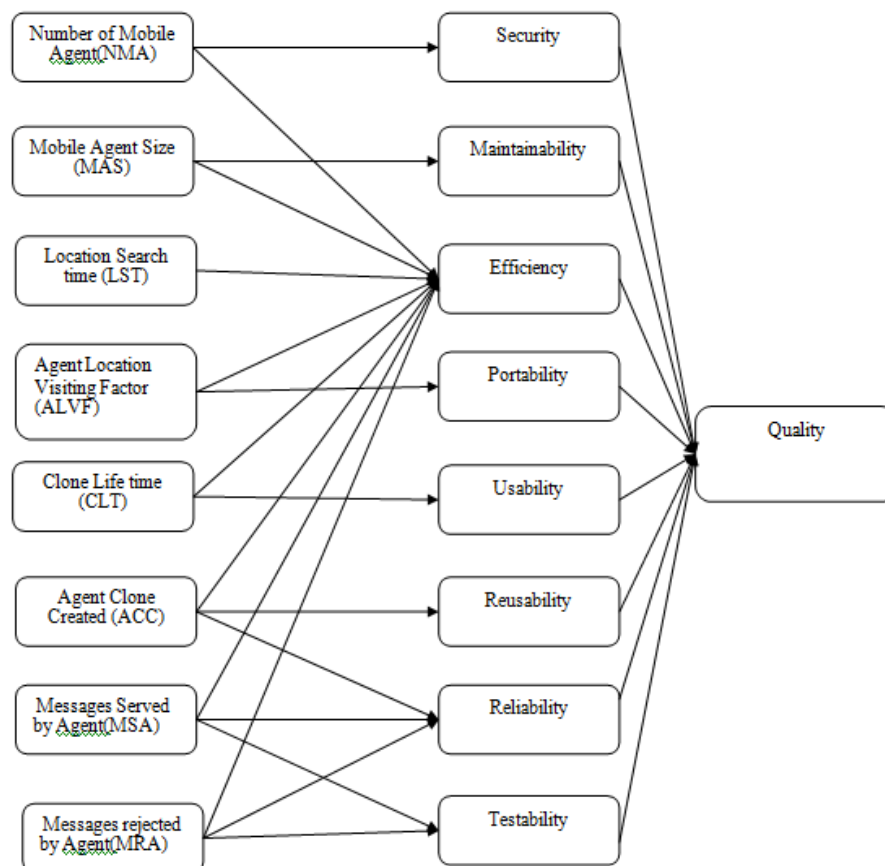

Figure 1. Quality Model for Measures and Quality Factor

The Above figure shows impact of measures on various quality factors. The measures have an impact on the efficiency; either it increases the impact or decreases impact on mobile agent. This figure also shows that all measures gives better results for quality.

IV. ANALYSIS OF MEASURES

4.1 NMA

As this measure is used to count the total number of mobile agent. Three quality factors efficiency, maintainability and security will be affected. If this measure will increase than security will decrease and maintainability will increase. Efficiency will slowly increases as this measure increases and remains constant up to a limit and then decrease slowly if limit exceeds.
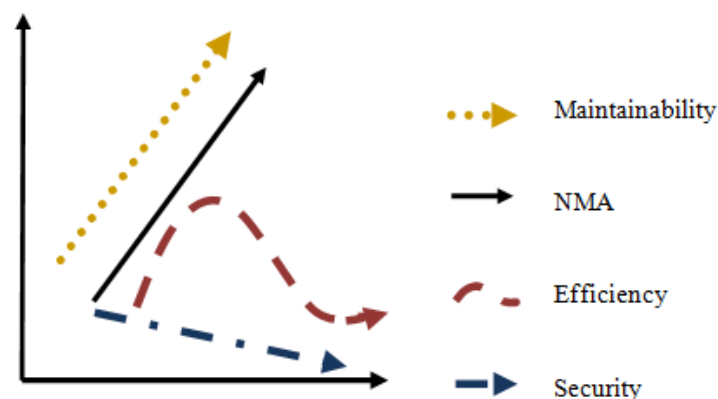
Figure2. Plot Representing Quality Factors with Respect to NMA Measure

4.2 MAS

It is total number of executable statements present in the program if the value of this measure is more than the size of data then it will decrease efficiency ,usability and portability of mobile agent because in that case there is no use of mobile agent as it cannot move easily and become less usable. Increased size will also increase the maintainability.
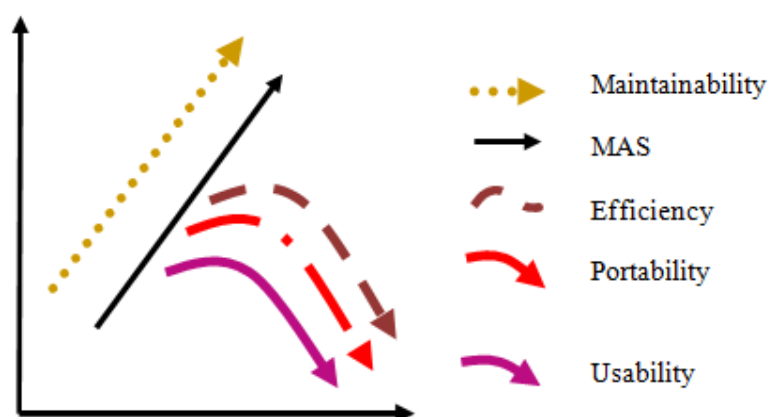

Figure3. Plot Representing Quality Factors with Respect to MAS Measure.

4.3 LST

This measure can be defined as the time taken by a mobile agent in searching a required location among available locations. Factors affected by this measure are Efficiency and Testability. As the number of locations

visited by mobile agent increases efficiency will decreases because it proves that mobile agent is busier in searching rather than transiting.
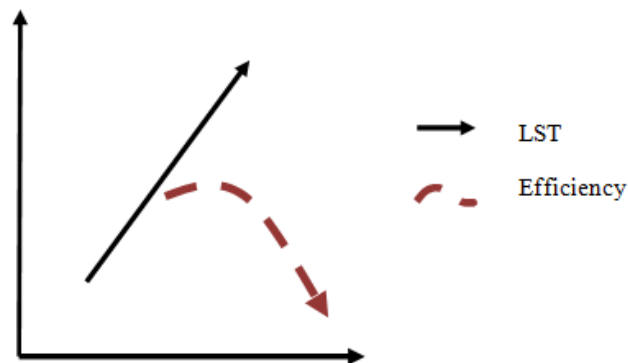

Figure4. Plot Representing Quality Factors with Respect to LST Measure

4.4 ACC

It is the total number of clones created by the mobile agent. Mobile agent may be accessed or captured by a unauthorized unit in the network to reduce this security risk clones may be introduced. More clones mean more reliability, reusability and maintainability. But efficiency will decreases exponentially, more clones does not mean more efficiency.
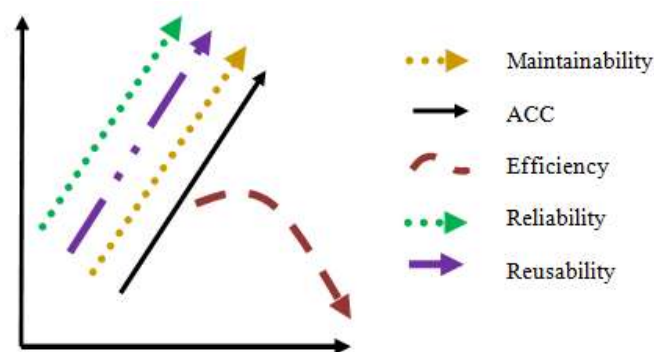

Figure5. Plot Representing Quality Factors with Respect to ACC Measure

4.5 CLT

CLT can be defined as the total time taken by a clone after initiation, visiting locations, transition and reporting followed by termination. Factors affected by these measures are efficiency and usability. Increased CLT means clone is consuming more time in transition and reporting so its not a efficient and more usable clone.
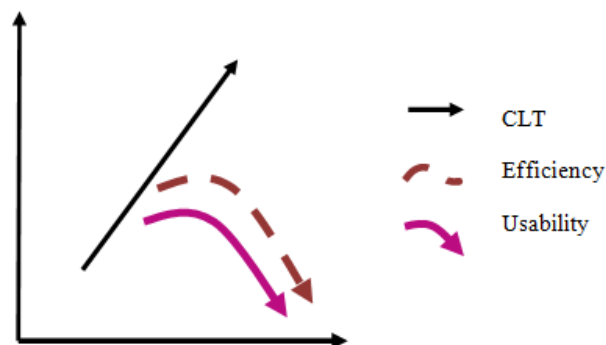

Figure6. Plot Representing Quality Factors with Respect to CLT Measure

4.6 MSA

It is the total number of messages served by agent that makes a mobile agent more efficient and reliable so quality factors affected by this measure are efficiency, testability, reliability where reliability will increase and up to a limit efficiency will increase and after this limit it will decrease exponentially.
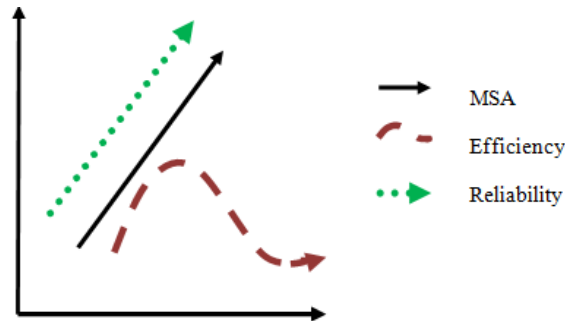

Figure7. Plot Representing Quality Factors with Respect to MSA Measure

4.7 MRA

It is the number of messages rejected by mobile agent that may creates   some doubt on its efficiency, testability and reliability. If a mobile agent is rejecting or not responding to more messages it will reduce reliability and efficiency of the system exponentially.
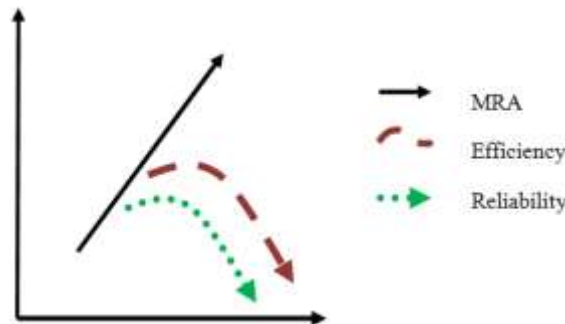

Figure8. Plot Representing Quality Factors with Respect to MRA Measure

4.7 ALVF

It is defined as the number of locations visited by an agent during its lifetime. Factors affected by this measure are Testability, portability, and efficiency. Portability will be increased as the ALVF increases as visiting more location proves mobile agent is more portable. Efficiency will decrease exponentially as agent is not transiting but wasting its time in visits.
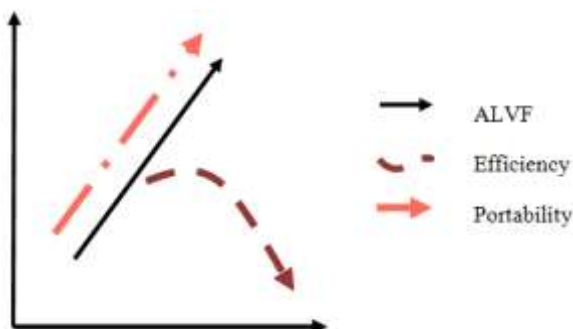

Figure9. Plot Representing Quality Factors with Respect to ALVF Measure

V. CONCLUSION

Mobile agents are special agent and the use of these agents makes agent oriented technology more attractive and advantageous. To improve their performance we must check them on various quality factors before use and to check these quality factors metrics are required. This paper concludes the eight measures of mobile agent and their impact over eight quality factors. Mobile agent measures used in this paper are NMA, MAS, ACC, LST, CLT, MRA, MSA and ALVF. These measures are analysed with quality factors that are Efficiency, Testability, Reliability, Usability, Reusability, Maintainability, Portability and Security. All eight measure check efficiency of mobile agent. One of the key targets in embarking in this exercise was to evaluate the mobile agent measure's quality.

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