International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 4 Issue: 2 070 - 076

A New Prototype for Intelligent Visual Fraud Detection in Agent-Based Auditing Framework

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Abstract:- While US. Sarbanes Oxley act has been viewed by most as an onerous and expensive requirement; it is having a positive impact on driving appropriate levels of investment in IT security, controls, and transactional systems. This paper introduces a new secure solution for auditing and accounting based on artificial intelligence technology. These days, security is a big issue among regulatory firms. Big companies are concerned about their data to be disseminated to their competitors; this high risk prevents them to provide full information to the regulatory firms. This solution not only significantly reduces the risk of unauthorized access to the company's information but also facilitate a framework for controlling the flow of disseminating information in a risk free method. Managing security is performed by a network of mobile agents in a pyramid structure among regulatory organization like securities and exchanges commissions, stock exchanges in top of this pyramid to the companies in the button. Because of security considerations, our strategy is to delegate all fraud detection algorithms to Intelligent Mobile Auditing Agent and web service undertake all inter communicational activity. Web services can follow auditing actives in predefined framework and they can act based on permitted security allowance to auditors. The current solution is designed based on Java-based mobile agents. Such design reaps strong mobility and security benefits. This new prototyped solution could be a framework for strengthening security for future development in this area. An insider trading case study is used to demonstrate and evaluate the approach.

Keywords:-*Continuous Auditing, Fraud Detection, Electronic Surveillance Systems*

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1. INTRODUCTION

A template is a set of styles and page layout settings that determine the appearance of a document. This template matches the printer settings that will be used in the proceeding and the CD-Rom. Use of the template is mandatory.

Clearly explain the nature of the problem, previous work, purpose, and contribution of the paper.

2. INTRODUCTION

In 2002, the United States Congress enacted the Sarbanes-Oxley (SOX) Act in an effort to stem the tide of corporate accounting scandals which unraveled over the course of the past several years, and to restore investor confidence in the corporate world and the stock markets. This Act dictates guidelines for the creation and maintenance of a comprehensive accounting framework. The purpose of this framework is to guarantee consistent and transparent public disclosure of all relevant financial data — disclosure that is free of subjective interpretations of a firm's financial performance. Via using an intelligent auditing framework, compliance procedures and controls can be designed and tested, and documentation procedures can be better managed, as per Section 404 requirements. Financial controls can be tested automatically to ensure compliance. Additionally, powerful process monitoring can be invoked, with notifications generated to garner greater managerial involvement in compliance efforts related to Section 409 of the SOX Act.

How an auditing firm can establish control cover effectiveness of the company's disclosure and set procedures for detecting frauds? How companies adopt to SOX responsibilities without heavy costs? How managers of companies can eliminate the risk of disclosing their private information to their competitors?

Does IT have to deliver the tools necessary to monitor the processes and controls to produce SOX compliance controls? For large companies with more than $5 billion in annual revenue, is it true that SOX's expected bite exceeded $8 million? The real challenge for IT is to not only be aware of regulations and regulatory changes based on SOX but to modify processes in a timely manner to keep pace with them. IT can get in work modern intelligent technology to not only upgrade quality of control but also minimize the cost of compliance with SOX.

This paper introduced a new secure solution for fraud detection auditing industry based on artificial intelligence technology. Our aim is to introduce prototype of a new secure framework for effective continuous auditing and supervision on companies that could provide new facilities for managing surveillance duties by software agent and get benefit from visual interface for automated fraud detection process, using emerging AI technology to maximize performance and minimize the security risks. As we review in the next section, previous research work on various aspects of continuous auditing solution but this is the first solution that is conducted on supporting intelligent, visual fraud detection using a secure, saleable mobile agent network. Also, it is first time that a language-we named it H language- is designed for automating fraud detection algorithms. Author believes that implementing H language can make a great evolution in supervision industries.

A June 2006 PricewaterhouseCoopers survey finds that 50% of U.S. companies now use continuous auditing techniques.

CA is a result of a fundamental transformation in business operations and control. AICPA WebTrust, GreenStein and SysTrust were the example of first Assurance Services. CA is now beginning to transition from the future of auditing to the practice of auditing. Firms around the world are starting to implement systems that have recognizably CA in their characteristics. For finding CA solution until 2007,we can perform four steps:

- Keyword search using the Continuous Auditing Services and Auditing Agent and
- Reviewing of relevant journals ,
- conferences
- and finally Reviewing of references of publications identified in step 1, 2 and 3

We found current solutions about CA services including.

Search results demonstrate that there are significant writings and discussions about CA in the last several years. While there seems to be an increase in interest in CA, there are limited solution are developed in the industry scale.

Also, the results indicated that only a few famous research solutions appear in the results, with two of them has implemented intelligent agent technology in their solutions. We have not found any result for "Intelligent Continuous Auditing Framework".

Our findings for CA solutions until 2008 are categorized in the three below periods:

- From 1960s to 1990
  - Embedded audit modules (EAMs)(Began in the 1960s)
  - Computer-assisted audit tools and techniques (CAATTs) (In the 1980s)
  - Continuous Process Auditing System (CPAS),(In the period from 1986 to 1990, AT&T Bell Laboratories)
- From 1990 to 2003
  - Virtual auditing agents, the EDGAR Agent, (Kay M. Nelson, Rajendra P. Srivastava, Alex Kogan, Miklos A. Vasarhelyi , 1998)
  - Continuous Auditing Web Services (CAWS) Model,(Murthy, U.S., Groomer, S.M.,2003)
- After 2003
  - Tertiary Monitoring and Logging of Continuous Assurance Systems(Michael Alles, Alex Kogan, Miklos Vasarhelyi,2004)
  - Business Process Execution Language for Web Services (BPEL4WS)(Murthy and Groomer, 2004)
  - Machine-independent audit trail analyzer (MIATA).(Peter J. Best; George Mohay; Alison Anderson,2004)
  - Financial Reporting and Auditing Agent with Net Knowledge (FRAANK), (2005)
  - Agent-based continuous audit model (ABCAM), (Charles Ling-yu Choua, Timon Dua and Vincent S. Lai,2005)

To summarize the findings, we can categorize previous CA solution until 2007 in below classes:

- Tools-based solutions
- Agent-Based solutions
- Service-Based solutions

There are two major challenges to building continuous auditing: (1) How to model efficiently various fraudulent cases in various industries? (2) How to apply efficient and continuous detection model in various industries without intervention of human experts? This study tries to address the second issue and to propose new approaches. The remainder of the paper is structured as follows. Section 2 reviews existing work on continuous auditing development, fraud detection tools, and its evolutions.

In Section 3, we discuss some problems with existing solutions and pose our research questions. Section 4 describes in detail our proposed approach. Section 5 describes an experiment designed to evaluate our approach and presents experimental results bases on a case study. In Section 6, we conclude our paper with some discussion and suggestions for future research directions.

3. PRIOR RESEARCHES

3.1. REVIEWING DEVELOPMENT OF CA SOLUTIONS UNTIL 2007

In this section we take a brief review of developed CA solution that began from developing EAM, CAATTs, EDGAR (single) Agent solution and finally FRAANK solution in 2005.

3.1.1. FROM 1960S TO 1990

The origins of automated control testing began in the 1960s with the installation and implementation of embedded audit modules (EAMs). This solution is designed for

- Using alert for alarming illegal conditions.
- Immediate reporting engagements

By the late 1970s, auditors began moving away from this approach.

In the 1980s, the audit profession began using computer-assisted audit tools and techniques (CAATTs) for ad hoc investigation and analyses. Also, this solution was known as Computer Assisted Audit Techniques or Computer Aided Audit Tools (CAATS). Auditor should manually auditing task with a series of tool-based test scenarios. CAATTs could refer to any use of a computer during the audit. This would include utilizing basic software packages such as Excel, Microsoft Access, and even word processors.

3.1.2. FROM 1990 TO 2003

In this period many solutions were developed for searching the client database for information, and reporting the information back to the auditing firms. All systems need a data source of accounting terms and their synonyms (ex. FRAANK-2003). Emergence of new standard to auditing industry (ex. XBRL) makes a great evolution in continuous

auditing solutions. The results was re-developing of many of previous solution (ex. FRAANK)

For the next generation of XML-based accounting systems, Murthy and Groomer (2004) present a model for a continuous audit business process, referred to as continuous auditing web services (CAWS). The audit firm would run the web service on its own computing environment and apply the CAWS to provide audit information about the business processes in the client's environment. [34]

In 2005, FRAANK was re-designed on 3-Tier programming model based on XBRL. FRAANK stands for Financial Reporting and Auditing Agent with Net Knowledge (FRAANK), (2005). It refer to online data available in the internet like EDGAR filling، Internet portal Yahoo, Quote.com and News feed. [7]

In 2005, Agent-based continuous audit model (ABCAM) was design on an agent-based framework. This solution tried to improve auditing performance especially when industry is changeable. Using XML made it capable to adapt to various ERP systems.

4. RESEARCH QUESTIONS

Although above solutions provided a promising alternative for Auditing information systems, they are not satisfied all requirements of auditing users in various business.

Security features were not supported in Embedded audit modules (EAMs). Also, the automation degree of continuous auditing process was minimum level and also don't cover automation all auditing processes. EAMs were not often used because they required high-level knowledge of information technology. These modules are very hard in build, development and maintain, and were used in a few organizations. In Computer-assisted audit tools and techniques (CAATTs, auditors still need a familiarity with software tools and IT knowledge and experience in using the application. Auditor must care the timing of availability of certain data, such as transaction details, this make auditor to alter the timing of the work that requires such data. Also same as EAMs, security features were not fully supported. Use of CAATTs by auditors may concerns client over the security of confidential or sensitive data. From 1990 to 2003 we found an improvement in user friendly of surveillance tools but security level still was not supported. In these systems a high level of trust was required. All systems need a data source of accounting terms and their synonyms (ex. FRAANK-2003)

While the CAWS have proposed the use of XML technologies or XBRL (eXtensible Business Reporting Language) tags for reporting, many of the current accounting systems, especially in small businesses, are still not using XML web technologies. CAWS perhaps is ideal for large companies that can afford advanced technologies and web services but may not be suitable for small companies that are using proprietary accounting systems. Moreover, though both BPEL4WS and XBRL GL currently represent alternative approaches to the structure of business processes, the architecture of CAWS was built using only BPEL4WS but with no obvious advantages, while XBRL GL and other general approaches were not explored. [34] In FRAANK solution (2005) we found no solution for exploring company data like GL data. The concept mobile agent was applied with no support for Neural Net and fraud detection. Also we found no support for dynamic interaction with auditors and agents. Table 1 demonstrated the auditing solution attributes.

Table 1 comparison of auditing solution

	EAMs	CAATTs	CAWS	FRAANK	ABCAM	IVFD
Security considerations	not supported	not fully supported	not supported	Managed by service	Managed by service	Managed by agent
Automation degree of continuous auditing process	minimum level	Middle	Static(Alerts)	Static(Service)	Static(Service)	Dynamic (Visual Workflow)
Required high-level knowledge of information technology	high-level of IT knowledge is required for users	auditors still need a familiarity with software tools	auditors still need a familiarity with services	auditors still need a familiarity with services	auditors still need a familiarity with services	End-User Manual
Development and maintain complicity	very hard in build	Need development per client	Need development per Service	Need to be developed per Service	Need to be customized per client	Package (Independent of client system)
Data access	Poor	Auditor must care the timing of availability of certain data	need a data source of accounting terms and their synonyms	Depend on external services	XML	XML
Industry scale	All companies	All companies	Just big Companies	All companies	Just big Companies	All companies
XBRL	Not supported	Not supported	Just XML	Yes	Yes	Yes
XBRL GL	Not supported	Not supported	Not supported	Not supported	Yes	Yes
Market Data	Not supported	Not supported	Not supported	Limited	No	MMTP(High)
Mobile Agent	Not supported	Not supported	Not supported	Yes	Not supported	Yes
Intelligent capabilities	Not supported	Not supported	Not supported	Intelligent capabilities	Not supported	Fuzzy-Neural Network
Dynamic Fraud Detection	Not supported	Not supported	Not supported	Not supported	Not supported	Yes
Fraud Types Supported	Simple Financial Transaction	Simple Financial Transaction	Financial Alert	Financial Fraud	Financial Fraud	Financial, Price Manuplation and Insider Trading

In this study, the following research questions are investigated: (1) Can intelligent agents be used to efficiently detect fraud detection? (2) Can visual workflow be used to enhance help creating of dynamic fraud patterns? (3) Can intelligent agent facilities detection of insider trading fraud pattern using dynamic workflow?

5. VISUAL FRAUD DETECTION IN AGENT-BASED SYSTEM

Intelligent agents are autonomous computational entities capable of making decisions independently and without the intervention of other entities, e.g. humans. They can be proactive, purposeful and exhibit goal-directed behavior, as well as reactive and responsive to changes in the environment. They can interact and modify their environments, and most importantly they can interact with other agents. A key feature of an agent is autonomy. Being autonomous distinguishes them from objects in the object-oriented paradigm. Autonomy allows system development to be enhanced with the embedding of desired actions into modular units, which can operate individually and independently. As a consequence they lead to more flexible designs, and since the processing is distributed, better performance can be obtained in practice.

Auditing robot is a virtual, artificial agent that is designed for auditing proposes. The word robot is used to refer to both semi-physical robots and virtual software agents. In the future developments we can develop vision and image processing, speech recognition as well as talking and human like communication and also investigating fraud outside the computer system, including illegal acts, but our scope of this paper is limited to artificial software agents. After passing this step, work can continue in mentioned area and off course, it would be a topic for Future work. If this framework be successfully established, designing a real auditing robot would not be impossible and we can have it in reality.

For running this structure we establish robot agents in several levels to interact with expert person with different roles in same level execute master expert person requests in upper levels or execute permitted client human expert requests in lower levels example in member firms. In this case we will introduce auditing robot and show how these interactions can be managed.

6. INTELLIGENT AGENT DESIGN

The word intelligent comes from Artificial Intelligence field. AI's main goal is imitation of human intelligence by mixing the science and engineering of making intelligent machines. Intelligent Auditing Mobile Agent can reduce human workload by delegating auditing tasks to IAMA that normally would require human-like intelligence.

Reactivity, pro-activeness and social ability make the agent to behavior like humans. They are able to perceive their environment, and respond in a timely fashion to changes that occur in it in order to satisfy its design objectives Also they are able to exhibit goal-directed behaviour by taking the initiative in order to satisfy its design objectives. Finally, intelligent agents are capable of interacting with other agents (and possibly humans) in order to satisfy their design objectives.

Another advantage of intelligent agents in improvement of computational intelligence is attained via iterative development or learning. As we see in next section, agent can interact with web services to get better results. They enjoy from learning techniques. Agent can enable pattern recognition capabilities via neural networks. Such network is possible by collaboration between intelligent agents in multi agent systems. Techniques for reasoning under uncertainty,-as we explain in next section- performed by decision making agents in Fuzzy systems.

7. CASE STUDY:

To demonstrate and evaluate the usefulness and usability of our new solution, I applied it to a fictitious but realistic fraud detection case study. The case study is based on the insider trading case of the stock exchange trading market.

13.1 Insider Trading Fraud Case description

The ENRON Scenario:

- Many draft contract to speed up the recognition of revenue while minimizing dept exposure
- Complex partnership subsidiaries know as SPE for transferring large amount of dept of ENRON balance sheet
- By August 2000 ,stock price hit an all time high
- Fraud trade made by ENRON CFO with his owned SPEs for sending 40 M$ out of the ENRON
- Selling 70.1 M$ until October 2001 by senior manager(Insider Trading)
- By December 2001, was the biggest bankruptcy in the US history

Insider trading case is demonstrated in Figure 3.

13.2 Future Work and research limitations: Simulation model construction

This fraud is detected by simulated fraud model that is demonstrated in fig.3. Collaboration between Insider Trading Agent, Insider Revenue Agent, Company Revenue Agent and Auditor Reporting Agent made it possible to detect trade in timely manner. Regulators can change the scenario to detect various type of fraud and can save and reload it as component.

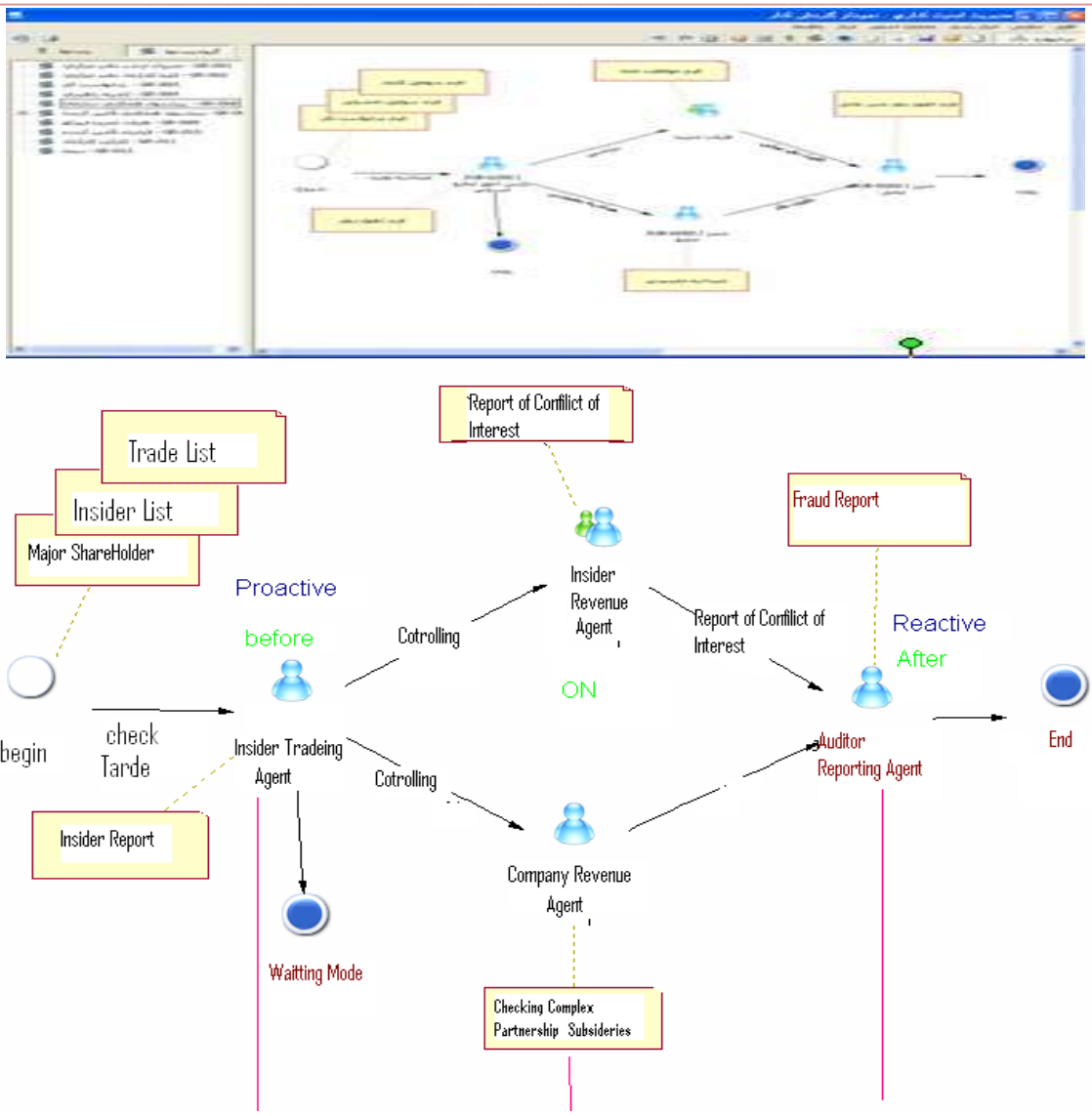

Fig. 3A Demonstrates IVF agent work flow management console. Fig. 3B Demonstrates insider trading detection model.

Although we tried to analyze various practical aspect of our solution but there some consideration that we couldn't discuses in first time and should be followed in details for next researches, Critical issues that determine the usability of the proposed prototype e.g., security of mobile agents on malicious platforms would be topic for next research. Also, we plan to implement current prototype in a surveillance stock exchange. Also future research can work out to consider different prospective of this solution like designing intelligent languages for supporting agent interactions, optimizing model for getting benefit form a security performance and also consideration of effect of using model in the business scale.

8. CONCLUSION

This paper reviewed previous solution about fraud detection which has been developed in auditing context in recent years. Also it analyzed all solution by various aspects. We proposed a new solution that have good features of previous solution and also provide new interface for dynamic deigning of fraud detection model. Fraud detection model was designed in Intelligent Visual Fraud desktop. In this desktop all event of the market is controlled by the network of intelligent agents.

In the first look, it may seems that sending auditing agent to various locations may lead to probability of some security risks, but establishing a secured managed framework and involving encapsulated –hiding logic – intelligent agents make security risk low. Also, this framework could be a framework for strengthening security for future development in this area. This would be lead to a significant improvement in security in comparison with other solutions.

Raising simplicity and speed of surveillance and simultaneously high degree of accuracy in detecting fraudulent cases would enable SEC regulator to have a real-time continuous control over issuer companies and spending their time on thinking and analyzing information instead of watching row financial statement data.

This simple solution have many benefits that take effect on legal prosecution of fraud, the way of proving crime via simulation of happening frauds and also new opportunities like applying rapidly new algorithm of fraud detection in all companies in a real-time manner. Finally, we PCAOB can have more precise control over auditing firm by assessing auditing firm by exact quantitative factor and ranking them by quality of the results.

ACKNOWLEDGMENT

We would like to thank to Dr. Behnam Rabiee for his kind cooperation in development of this research.

NOTES

[1]Intelligent Auditing Mobile Agent,IAMA
[2] Intelligent XBRL,I-XBRL
[3]HESABRAS, A interpreting languages that is designed for using as interaction language between human and IMAA that make it possible to automate accounting and auditing tasks.
[4]Auditor Holding Firm, AHF
[5]XBRL, (Extensible Business Reporting Language) is an emerging XML-based standard to define and exchange business and financial performance information.

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