

Executive Information System for Loan Processing and Approval Using Two-Way Verification Method

Lance Jay T. Montalban, Ramil G. Lumauag

Abstract: This study aimed to develop an Executive Information System for Loan Processing and Approval Using Two-way Verification Method. A loan processing system was developed to access loan information through web and mobile application with SMS notification. The system is capable to determine borrower's credibility, and a two-way verification mobile access code for security and authenticity was employed. The Agile Methodology for software development was used in the development of the system. The experimental and comparative evaluation was also used for testing the parameters of loan transaction and loan approval from manual to automated. The system was tested for accuracy, precision and recall using F-Measures and the ISO 9126 for its functionality, reliability, usability, efficiency, maintainability and portability. The findings of the study revealed that the Executive Support System for Loan Processing and Approval Using the Two-way Verification Method was accurate based on the result of the F-Measure and very effective based on the result of the ISO 9126 evaluation.

Index Terms: Decision Support System, Executive Information System, Loan Processing System, Short Message Service (SMS).

I. INTRODUCTION

Credit cooperative is a financial organization organized, owned and operated by its members with the following objectives: to encourage savings among its members, to create a pool of such savings for which loans for productive or provident purposes may be granted to its members and provide related services to enable its members to maximize the benefits from such loan. [1]

One of the major services of the cooperative is the loan application and processing where the applicants are evaluated based on their credit standing. The manual processing encountered problems in the processing of data in the lending operations and approval of loan applications. There is a difficulty in determining the member's payment history which is necessary to evaluate the future payment performance of the borrower. Another problem enumerated was to determine the credit limit of the borrowers.

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The filling and retrieving of loan records of the members is time consuming and the availability of loan personnel officers for signing and evaluating of loan application. In this era of rapid development in technology, responding to problems mentioned is just a system away.

It mainly takes one's expertise and availability of resources to realize such concern [2].

Web application is the trend nowadays. This application is designed to run on mobile devices such as smart phone and computer tablets which are connected to the Internet to provide faster and efficient services [3].

Nowadays, the evolution of information technology applications makes it an absolute obligation on behalf of the decision makers to continuously make the best decisions in the shortest possible time [4].

The purpose of this study was to develop a web application to improve the efficiency and productivity of lending services of the cooperative. It has a decision support system which enables it to decide whether to grant or deny a loan application. This study has a secure loan processing system using two-way verification method [5] for the security of the system against fraudulent user or system hacker.

Through mobile phones, the borrower can apply for a loan and the system has an SMS Notification [6] to notify the co-maker.

Statement of Objectives

Generally, the study aimed to develop an Executive Information System for Loan Processing and Approval Using Two-way Verification Method.

Specifically, the study aimed to:

1. develop a loan processing system that could be accessed through web and receive notification through SMS;
2. develop a system for loan approval which is capable of determining the borrower's credibility, net pay, loan balance and capital build-up;
3. use a two-way verification method for the security of the system;
4. evaluate the accuracy of the system using the F-measure; and
5. evaluate the system using ISO 9126.

Conceptual Framework

A conceptual framework is an interconnected set of ideas about how a particular function is related to its parts. The framework serves as the basis for understanding the correlational patterns of interconnections across the events, ideas, observations, concepts, knowledge



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interpretation and other components of the study [7].

Executive Information System for Loan Processing and Approval Using the Two Way Method is a system designed to encode member's personal information and loan details to reduce or minimize the time spent in encoding, preparing and evaluating of loan application and credit history data. This requires an Administrator database for sorting data and information sending for purpose of notifying.

Figure 1 illustrates the conceptual framework of the study

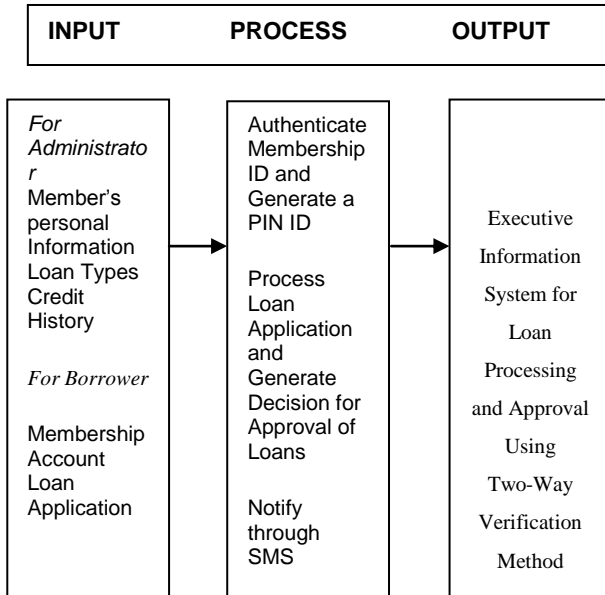


Figure1. The Conceptual Framework of the Study

For the system to operate, the inputs required from the administrator include the member's information such as their profiles and other background information; capital build-up and net pay; the types of loan classified as major or minor; and credit history data which involves loan payments and balances.

For the borrower, the inputs are the membership account ID and membership PIN ID. The membership account will be used to authenticate the membership ID and generate a PIN ID.

The generated PIN ID gives access to the member borrower to the online web services. The member will select a loan type or accept nomination as co maker. The borrower will submit the loan application to the system.

In processing a loan application, the system will evaluate the application using a decision support and will generate decision for loan approval.

The purpose of SMS notifications is to notify the members and co-maker for the approval of loan.

The output is the Executive Information System for Loan Processing and Approval using Two-way Verification Method tested and evaluated using the F-Measure and ISO 9126.

II. METHODOLOGY

Project Development

System Development Methodology refers to a standard process followed in an organization to conduct all the steps necessary to analyze, design, implement, and maintain information systems.

Agile Methodology is an incremental, repetitious means of managing projects; particularly in the field of software development. These iterations, or sprints, give project managers many opportunities to evaluate and change the project during its lifecycle as well as keeping the end user informed and involved in development [8].

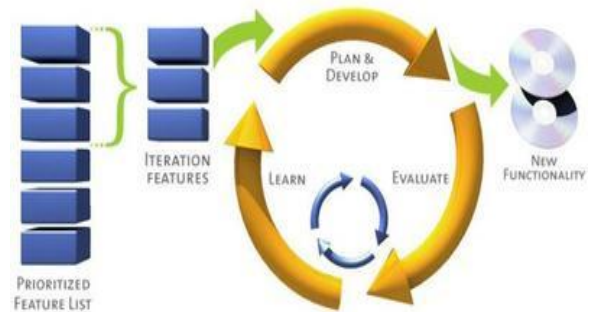


Figure 2. Agile Methodologies [8]

Figure 2 shows the steps of Agile Methodologies which focus on iteration and adaptable to change.

Iteration 1 (Prioritized feature list) – Identify the potential project, objectives and scope, gather the initial requirement, and develop initial vision. This phase includes the planning and conceptualizing of a Loan Processing application problem, system input, and gathering a list of information from the cooperative policies.

Iteration 0 (Sprint Backlog/ Warm up) – Initialize the project, plan session, identify the highest priority requirement, collect work items for current iterations and identify work task. This phase includes the Initialization and method of the Executive Information System and Decision Support System for loan approval and encode the member's information and loan details, credit history, Capital Build-up and Net pay.

Construction Iteration – (Sprint Task) - Develops a working system which meets the needs of stakeholder, collaborative development, model storming, confirmatory testing and internally deploys software for sharing status and Identify the potential. This phase includes the development of a mobile loan application and Executive Information System (EIS) for loan approval system, security and authenticity of the system and SMS Notification.

Release (Sprint Review and Testing) – Review and testing of the system, final acceptance pilot test and release the system to the cooperative, train end user & staff then deploy system into production. evaluate and test EIS, security and compatibility of the mobile application to the system.

Production (New functionality/ retirement) – Operate and support system in accuracy of loan application & computation of terms and interest, the user friendly and effectiveness of the system. The production identifies defects and enhances request data conversion, updates model



of final version of the systems, and remove the system from production update enterprise model.

Project Evaluation

The system was tested for accuracy, precision and recall using F-Measures [9]. It was also tested using the ISO 9126 [10] for its functionality, reliability, usability, efficiency, maintainability and portability

To test the accuracy of the Decision Support System, the F- Measure was used. There were 30 samples from the previous loan application treated. The result of the manual and automated system was compared. A confusion matrix [9] was evaluated to tabulate the comparison by getting the number of True Positive, True Negative, False Negative, False Positive.

TABLE I. THE CONFUSION MATRIX

Class	Approved	Disapproved	Total
Manual	TP	FN	P
Automated	FP	TN	N
Total	P	N	P+N

Table 1 shows the Confusion Matrix where True Positive (TP) is granted by both the manual and automated; True Negative (TN) is granted by the manual and denied by the automated; False Negative (FN) is denied by both the manual and automated ; and False Positive (FP) is denied by the manual and granted by the system.

To determine the accuracy of the study, the following computations were made.

Accuracy is the proportion of the total number of predictions that were correct. It is calculated using the equation:

$$Accuracy = \frac{True\ Positive + True\ Negative}{TP + FN + FP + TN}$$

Recall or Sensitivity or True Positive (TPR) – It is the proportion of positive cases that were correctly identified, as calculated using the equation:

$$Recall = \frac{True\ Positive}{TP + FN + FP + TN}$$

Precision P is the proportion of the predicted positive cases that were correct, as calculated using the equation;

$$Precision = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

F Measure computes some average of the information retrieval precision and recall metrics.

$$\frac{1}{F} = \frac{1}{2} \left(\frac{1}{R} + \frac{1}{P} \right) = \frac{P + R}{2PR}$$

To evaluate the quality attributes of the system, ISO 9126 otherwise known as the Software Quality Model in terms of six main characteristics of good software namely, functionality, reliability, usability, efficiency, maintainability and portability was used.

The researcher used the five (5) point Likert Scale as the basis for evaluating the system (see appendix F).

The result of the evaluation was tabulated using the Statistical Package for Social Sciences (SPSS) software and the mean was used as the measure.

III. RESULT AND DISCUSSIONS

Evaluation of the System through F – Measure

The system used the F-measure to evaluate the accuracy and effectiveness using the 30 samples from the previous loan application and classified as to true positive, true negative, false positive, and false negative.

Test the accuracy of the system, using the thirty (30) samples randomly chosen. Twenty-three (23) of the respondents are classified as true positive (granted by both manual and automated); four (4) are classified as true negative (granted by manual denied by the automated); three (3) are considered as false negative (denied by both the manual and automated); and zero (0) as for false positive (denied by the manual granted by the system).

Computation :

- Total number of Samples = 30
- No. of True Positive = 23
- No. of True Negative = 4
- No. of False Negative = 3
- No. of False Positive = 0

$$True\ Positive = \frac{23}{30} = 0.76$$

$$True\ Negative = \frac{4}{30} = 0.13$$

$$False\ Negative = \frac{3}{30} = 0.1$$

$$Accuracy = \frac{TP+TN}{TP+FN+FP+TN} = \frac{0.76+0.13}{0.76+0.1+0+0.13} = \frac{0.89}{0.99} = \frac{TP+TN}{TP+FN+FP+TN} = \frac{0.76+0.13}{0.76+0.1+0+0.13} = \frac{0.89}{0.99} = .89 \text{ or } 89\%$$

Result shows that the computed result for accuracy is 0.89 or 89% which means that the system is accurate.

$$Precision = \frac{TP}{TP + FP} = \frac{0.76}{0.76 + 0} = 1$$

The result shows that the computed result for precision is equal to 1.

$$Recall = \frac{TP}{TP + FN} = \frac{0.76}{0.76 + 0.1} = \frac{0.76}{0.86} = 0.88$$

The result shows that the computed result for recall is equals to 0.88

$$F\ Measure = \frac{1}{F} = \frac{P + R}{2PR}$$



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$$F = \frac{2PR}{P+R} = \frac{2(1)(0.88)}{1+0.88} = \frac{1.76}{1.88}$$

F Measure = 0.94 F Measure = 0.94 or 94%

The F Measure value using the harmonic mean of precision and recall is 0.94 or 94% which implies that the manual and automated systems are both precise and accurate.

Evaluation of the System Output by Potential Users

Two-way Verification Methods as Evaluated by the Cooperative Loan Member

The resulting mean and standard deviation (SD) of the gathered survey materials from 30 cooperative members were computed. The overall result of the system's level of effectiveness showed an evaluation rating of 4.79, described as "Very Effective." The SD of 0.0668 implies that the individual score are tightly grouped toward the total means of 4.79. The data set are more or less homogenous ranging from 4.72 to 4.86. This means that the two way verification method for the cooperative loan member is very effective in delivering its service.

Two-way Verification Methods Evaluated by the Technical Experts.

The resulting mean and standard deviation (SD) of the gathered survey materials from 10 IT experts were computed. The overall results of the evaluation revealed a "Very Effective" description with the overall mean score of 4.59. The SD of 0.0568 implies that the individual score are tightly grouped toward the total means of 4.59. The data set are more or less homogenous ranging from 4.54 to 4.64

Effectives of the System as Evaluated by the Cooperative Loan Members.

The resulting mean and standard deviation (SD) of the gathered survey materials from 30 cooperative members were computed. The overall result of the evaluation was "very effective". The SD of 0.0652 implies that the individual score are tightly grouped toward the total means of 4.78. The data set are more or less homogenous ranging from 4.71 to 4.85. This meant that the effectiveness of the system was very effective in delivering mobile service.

Effectiveness of the System as Evaluated by the Technical Expert

The resulting mean and standard deviation (SD) of the gathered survey materials from 10 IT experts were computed. The overall result of the system's level of effectiveness showed an evaluation rating of 4.60, described as "Very Effective". The SD of 0.1054 implies that the individual score are tightly grouped toward the total means of 4.60. The data set are more or less homogenous ranging from 4.4946 to 4.7054.

Evaluation of the Software Quality Standards based on ISO 9126 by IT Experts

Ten (10) Information Technology (IT) experts who were in line with database and mobile development were surveyed to gather feedbacks whether the system has complied with the quality standards set by ISO 9126.

The value of mean and standard deviation (SD) were computed to determine the general perception of IT experts. A high value of SD indicates a wide range of perception, while the low values indicate similarity or commonality on their perception.

ISO 9126 Survey Result

The overall result of the expert's evaluation on the system based on ISO 9126 criteria was "Very Effective" with the mean score of 4.57 and a standard deviation of 0.0568. The SD further implies that the system could meet the software quality characteristics set by ISO 9126 standards. This implied that the software is of good quality and could provide quality service to its clientele.

IV. CONCLUSIONS

Based on the findings of the study, the following conclusions were made:

1. The loan processing system as to its accessibility through web application and notification via SMS using a two-way verification method and its capability for loan approval and determining the borrower credibility is very effective.
2. F-measure signifies that the lower the number of true negative, the higher the accuracy. The result of the F-measure using the harmonic mean of precision and recall as to the level of accuracy showed that the system is more than accurate which means that the system functions as very effective.
3. The overall result of the expert's evaluation on the system based on ISO 9126 criteria was very effective. This means that the system meets the software quality characteristics set by ISO 9126 standards as to functionality, reliability, efficiency, maintainability, and portability.
4. Based on the results of the evaluation, the study achieved its objectives.

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AUTHORS PROFILE



Lance Jay Tristeza Montalban was born and reared in a family of educators. He reside at Brgy. Kirayan Sur, Miagao, Iloilo with an email address Lanzjay1113@gmail.com. And attended both public elementary and secondary schools. For his baccalaureate degree, he took up Bachelor of Science in Computer Science. His mastered followed where he enrolled Master of Science in Computer Science major in Networking at Iloilo Science and Technology University , La Paz Campus, La Paz, Iloilo City, finished his academic requirements, successfully defended his paper entitled “Executive Information System For Loan Processing And Approval Using Two-Way Verification Method” and eventually graduated last October 2016. He also holds National Competency 2 for Computer Hardware Servicing.

Currently, he is employed as Instructor I at Iloilo Science and Technology University Miagao, Campus, Miagao, Iloilo, teaching information technology subjects and conducting developmental research. And attended seminars on Web Application Security and Cyber Security conducted by Philippine Institute of Cyber Security Professional(PICSPRO).

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He believes in the way technology modifies life and that everything is possible when both hands are in control.



Ramil G. Lumauag is the Head of the Office of Instruction of Iloilo Science and Technology University Miagao Campus, Miagao, Iloilo, Philippines. He obtained his Doctor of Education degree at the University of the Visayas Cebu City in 2016. He finished his Master of Science in Computer Science at the University of Negros Occidental-Recoletos Bacolod City, the same university also where he finished his Bachelor of Science in Computer Science degree.

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In the field of research, he had presented several research papers in local, regional, national, and international forum. He had also published several papers in various CHED Accredited Journals and reputable International Journals.