# TABLE OF CONTENTS

Acknowledgement........................................................................................................i
List of Tables..................................................................................................................ii
List of Figures................................................................................................................iii
Abbreviations................................................................................................................v
Abstract..........................................................................................................................vii

**Chapter – 1 Introduction**.............................................................................................1
  1.1 Introduction ..............................................................................................................1
  1.2 Software Requirements ..........................................................................................2
  1.3 Stakeholders Requirements ..................................................................................5
      1.3.1 Stakeholders Data Preprocessing .................................................................7
  1.4 Feature Selection ....................................................................................................10
  1.5 Feature Classification ............................................................................................12
  1.6 Network Formation ................................................................................................13
  1.7 Clustering Similarity .............................................................................................13
  1.8 Software Model .....................................................................................................16
  1.9 Software Risk Evaluation .....................................................................................18
  1.10 Motivation ............................................................................................................19
  1.11 Objective .............................................................................................................19
  1.12 Scope and Delimitation ........................................................................................19
  1.13 Organization of Thesis .........................................................................................20

**Chapter – 2 Review of Literature**...............................................................................21
  2.1 Introduction ............................................................................................................21
  2.2 Preprocessing the Requirement ............................................................................22
  2.3 Feature Selection and Evaluation .........................................................................29
  2.4 Feature Classification ............................................................................................35
  2.5 Bayesian Network Formation ...............................................................................40
  2.6 Clustering Techniques .........................................................................................47
  2.7 Risk Assessment in Software Requirement Engineering ......................................55
  2.8 Summary ...............................................................................................................56
Chapter – 3 Stakeholder Requirement Clustering Algorithm (SRCA) for Requirement Clustering…………………………………………………………………..57
  3.1 Introduction……………………………………………………………………57
  3.2 Requirements of the Software Process………………………………………………………….59
  3.3 Requirement Engineering Process…………………………………………………………..60
    3.3.1 Feasibility Study……………………………………………………………………..60
    3.3.2 Requirement Elicitation………………………………………………………………..61
    3.3.3 Requirement Analysis……………………………………………………………………62
    3.3.4 Requirement Documentation………………………………………………………..62
    3.3.5 Requirement Verification and Validation……………………………………63
    3.3.6 Requirement Management…………………………………………………………63
  3.4 Stakeholders Data Evaluation…………………………………………………………63
  3.5 Feature Evaluation and Selection…………………………………………………..64
    3.5.1 Filter Approach…………………………………………………………………………64
    3.5.2 Wrapper Approach………………………………………………………………………66
    3.5.3 Hybrid Approach of Filter and Wrapper………………………………………..67
  3.6 Data Classification Based on FCM…………………………………………………69
  3.7 Bayesian Network Formulation…………………………………………………70
  3.8 Clustering of Stakeholders……………………………………………………………..72
  3.9 Summary………………………………………………………………………………74

Chapter – 4 Software Risk Evaluation Based on DAG Formation…………………76
  4.1 Introduction………………………………………………………………………………….76
  4.2 Stakeholders Requirements………………………………………………………..78
  4.3 Stakeholder Requirement Analysis………………………………………………78
  4.4 Clustering of Stakeholders…………………………………………………………79
  4.5 Directed Acyclic Graphs (DAG)………………………………………………………..79
    4.5.1 DAG Model Process……………………………………………………………………..80
    4.5.2 Component Based Software Model………………………………………………..81
  4.6 Correlation Matrix Prediction…………………………………………………………82
  4.7 Incorporating Risk Management into Software Requirement Engineering………………..82
  4.8 Estimation of Risk Management in Software Requirement Engineering………………85
  4.9 Risk Identification and Evaluation in Software Requirement Engineering………………85
  4.10 Risk Assessment in Software Requirement Engineering………………………87
LIST OF TABLES

Table 5.1 - Comparison between existing and proposed algorithms………………..94
Table 5.2 - Conditions for Fuzzy Rule Based Classification (FRBC)………………96
Table 5.3 - Precision and Recall Values for NB, C4.5 and Fuzzy Classification……97
Table 5.4 - Computation time, accuracy and MAE values for existing and proposed
            algorithms……………………………………………………………………..102
Table 5.5 - Time and Accuracy values for preprocessed, classified and clustered
            datasets………………………………………………………………………..107
LIST OF FIGURES

Figure 1.1- Relationship of the Software Requirements………………………………………………3
Figure 1.2 - Stakeholder Management……………………………………………………………..6
Figure 1.3 - Data Preprocessing……………………………………………………………………8
Figure 1.4 - Key Steps for Feature Selection……………………………………………………..11
Figure 1.5 - Software Development Model………………………………………………………16
Figure 2.1 - Overall process involved in Requirement Preprocessing………………………….28
Figure 2.2 - Overview of RSLingo approach: Usage at Project-level…………………………..30
Figure 2.3 - Processes Involved in Requirement Engineering…………………………………..41
Figure 2.4 - Cluster Based Component Selection Process Overview…………………………49
Figure 2.5 - Clustering of Requirements and Cluster Prioritization……………………………50
Figure 3.1 - Flow of the proposed method…………………………………………………………58
Figure 3.2 - Requirement Engineering Development Process………………………………….60
Figure 3.3 - Components of Requirement Elicitation………………………………………………61
Figure 3.4 - Interaction between the requirement elicitation and analysis………………………62
Figure 3.5 - Requisites Bayesian Network…………………………………………………………71
Figure 4.1 - Flow of the Proposed Method…………………………………………………………77
Figure 4.2 - Directed Acyclic Graph Representation………………………………………………80
Figure 4.3 - Process of Directed Acyclic Graph……………………………………………………81
Figure 4.4 - Overview of Business Specification and Requirement Specification………………84
Figure 4.5 - Risk Management in Software Requirement Engineering…………………………86
Figure 4.6 - Illustration of Risk Assessment…………………………………………………………88
Figure 5.1 - Comparative analysis between various feature selection algorithms………………93
Figure 5.2 - Selected features for original and preprocessed datasets…………………………94
Figure 5.3 - Comparative analysis between feature selection algorithms based on fuzzy classification accuracy………………………………………………………………………………95
Figure 5.4 - Comparative analysis between various classification algorithms…………………..96
Figure 5.5 - Classification accuracy for original and preprocessed datasets…………………..97
Figure 5.6 - Precision and Recall values for proposed and existing classification algorithms………………………………………………………………………………………………………98
Figure 5.7 - Bayesian network formation……………………………………………………………99
Figure 5.8 - Computation time for various clustering algorithms……………………………..100
Figure 5.9 - Accuracy level of various clustering algorithms
Figure 5.10 - Mean Absolute Error (MAE) for proposed SRCA algorithm
Figure 5.11 - Comparative analysis between various clustering algorithms based on MAE
Figure 5.12 - Level of risk
Figure 5.13 - Comparison between the existing and proposed algorithms based on the risk level
Figure 5.14 - Scalability of proposed DAG
Figure 5.15 - Reliability of proposed DAG
Figure 5.16 - Comparison between the datasets based on the time (ms)
Figure 5.17 - Comparison between the datasets based on the accuracy level
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANN</td>
<td>Artificial Neural Network</td>
</tr>
<tr>
<td>AO</td>
<td>Alternating Optimization</td>
</tr>
<tr>
<td>AR/CR</td>
<td>Ambiguous or Contradictory requirement</td>
</tr>
<tr>
<td>BN</td>
<td>Bayesian Network</td>
</tr>
<tr>
<td>CBS</td>
<td>Component Based System</td>
</tr>
<tr>
<td>CD</td>
<td>Classified Data</td>
</tr>
<tr>
<td>CLGs</td>
<td>Concrete Level Goals</td>
</tr>
<tr>
<td>COTS</td>
<td>Customer Off The Shelf Components</td>
</tr>
<tr>
<td>DAG</td>
<td>Direct Acyclic Graph</td>
</tr>
<tr>
<td>EUC</td>
<td>Essential Use Cases</td>
</tr>
<tr>
<td>FMs</td>
<td>Feature Model</td>
</tr>
<tr>
<td>FRBC</td>
<td>Fuzzy Rule Based Classification</td>
</tr>
<tr>
<td>IR</td>
<td>Incomplete Requirement</td>
</tr>
<tr>
<td>JAD</td>
<td>Joint Application Development</td>
</tr>
<tr>
<td>MAE</td>
<td>Mean Absolute Error</td>
</tr>
<tr>
<td>MAP</td>
<td>Mean Average Precision</td>
</tr>
<tr>
<td>MCSs</td>
<td>Minimum Cut Sets</td>
</tr>
<tr>
<td>MDBC</td>
<td>Make Density Based Clustering</td>
</tr>
<tr>
<td>MLSs</td>
<td>Minimum Link Sets</td>
</tr>
<tr>
<td>NB</td>
<td>Naïve Bayesian</td>
</tr>
<tr>
<td>NFR</td>
<td>Non-Functional Requirements</td>
</tr>
<tr>
<td>OLAP</td>
<td>OnLine Analytical Processing</td>
</tr>
<tr>
<td>OSI</td>
<td>Open Systems Interconnection</td>
</tr>
<tr>
<td>RALIC</td>
<td>Replacement Access, Library and ID Card</td>
</tr>
<tr>
<td>RBC</td>
<td>Requirement Based Complexity</td>
</tr>
<tr>
<td>RE</td>
<td>Requirement engineering</td>
</tr>
<tr>
<td>RTM</td>
<td>Requirement Traceability Matrix</td>
</tr>
<tr>
<td>SASD</td>
<td>Structured Analysis Structured Design</td>
</tr>
<tr>
<td>SASs</td>
<td>Self Adaptive Systems</td>
</tr>
<tr>
<td>SDL</td>
<td>Specification and Description Language</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>SPL</td>
<td>Software Product Line</td>
</tr>
<tr>
<td>SRCA</td>
<td>Stake Requirement Clustering Algorithm</td>
</tr>
<tr>
<td>SRE</td>
<td>Software Risk Evaluation</td>
</tr>
<tr>
<td>SRS</td>
<td>Software Requirement Specification</td>
</tr>
<tr>
<td>SRSD</td>
<td>Software Requirement Specification Document</td>
</tr>
<tr>
<td>SVM</td>
<td>Support Vector Machine</td>
</tr>
<tr>
<td>TQM</td>
<td>Total Quality Management</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
</tr>
<tr>
<td>UR</td>
<td>Unclear Requirement</td>
</tr>
</tbody>
</table>