CHAPTER 9
Experiments and Results of
Context-Based Rough Fuzzy Model

9.1 Introduction

Lack of comprehensive, reference set of visual recordings has been found in human emotion displays. Classical dance forms include abhinayas and are rich in gestures and emotions. As a result, it motivated us to develop datasets using dance sequences of Bharatanatyam. These dance sequences narrate certain scenes among inter-related images. Consequently, videos illustrating dance sequences of Bharatanatyam are used to develop Rough Set-based Decision Tables (RSDTs) using ontology-based framework. The development of RSDTs using ontology-based framework is presented in Section 7.3 of Chapter 7. Subsequently, RSDTs are used for evaluation of Context-Based Rough Fuzzy Model (CBRFM) as datasets. However, Table 9.1 lists some noteworthy visual data resources that are reported in the literature [232]. For each database, information is represented by emotion elicitation method (i.e., whether the elicited emotion displays are posed or spontaneous), size (number of subjects and available data samples), modality (visual), emotion description (category or dimension), and labeling scheme. The databases mentioned in Table 9.1 provide deliberate emotion behavior.

The FABO database of Gunes and Piccardi contains videos of facial expressions and body gestures [233]. Chen-Huang audiovisual database includes multimedia database containing facial deliberate displays of basic emotions and 4 cognitive states [234]. The gestures portray posed displays of basic and non-basic emotional states (six prototypical emotions, uncertainty, anxiety, boredom and neutral). Additionally, existing datasets of spontaneous emotion behavior are
Table 9.1: Multimedia Databases of Human Emotion Behavior

<table>
<thead>
<tr>
<th>References</th>
<th>Elicitation method</th>
<th>Size</th>
<th>Emotion description</th>
<th>Labeling Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>FABO face and body gesture [233]</td>
<td>Posed: two cameras to record facial expressions and body gestures respectively</td>
<td>23 adults</td>
<td>Category: 6 basic emotions, neutral, uncertainty, anxiety, boredom</td>
<td>CFHFM and CBRFM</td>
</tr>
<tr>
<td>Chen-Huang '00 [234]</td>
<td>Posed</td>
<td>100 adults, 9900 visual and AV expressions</td>
<td>Category: 6 basic emotions, and 4 cognitive states (interest, puzzle, bore, frustration)</td>
<td>CFHFM and CBRFM</td>
</tr>
<tr>
<td>Adult Attachment Interview '04 [22]</td>
<td>Natural: subjects were interviewed to describe the childhood experience</td>
<td>60 adults</td>
<td>Category: 6 basic emotions, embarrassment, contempt, shame, general positive and negative.</td>
<td>Facial Action Coding System (FACS)</td>
</tr>
<tr>
<td>RU-FACS '05 [235]</td>
<td>Natural: subjects were tried to convince the interviewers they were telling the truth.</td>
<td>100 adults</td>
<td>Category: 33 AUs</td>
<td>FACS</td>
</tr>
<tr>
<td>SAL '052</td>
<td>Induced: subjects interacted with artificial listener with different personalities</td>
<td>24 adults</td>
<td>Dimensional labeling/categorical labeling</td>
<td>DFA-VAS</td>
</tr>
<tr>
<td>Belfast database '03 [236]</td>
<td>Natural: clips taken from television and realistic interviews with research team</td>
<td>125 subjects. 209 sequences from TV, 30 from interview</td>
<td>Dimensional labeling/categorical labeling</td>
<td>DFA-VAS</td>
</tr>
</tbody>
</table>
collected from scenarios such as human-human conversation, human-computer interaction (SAL2), and clips from television [235, 236]. These databases use emotion descriptors to classify discrete emotion categories. These emotion descriptors are used to label prototypical emotions repeatedly used, especially in databases of deliberate emotion behavior. In databases of spontaneous emotion behavior, dimensional descriptions in evaluation-activation space and some application-dependent emotional states are frequently denoted as data labels. Interest, boredom, confusion, frustration, uncertainty, anxiety, embarrassment, contempt, and shame indicate some examples that employ application-dependent emotion-interpretative labels. We have compiled a collection of Bharatanatyam dance videos depicting short epics. Some narrations are performed by research scholar while others involved students of Dr. Urvashi, a renowned Bharatanatyam and Odissi dancer in Pune. These include dance performances, training and tutorials as well as many interviews.

Dataset of 30 videos with duration of 5-6 minutes each are realized to obtain stable and unstable sentiments as shown in Figure 9.1. The figure represents the overall system overview for classification of sentiments. Stable and unstable sentiments are recognized from given video using the models and sub-systems developed in the preceded chapters. Initially we obtain linguistic node structure of each video from Deterministic Finite Automata-based Video Annotation System (DFA-VAS). The linguistic node representation provides eminent frames as shown in Figure 8.2 of Chapter 8. Later, positive or negative coarse grained emotions and sentiments (or, fine grained emotions) are provided from Context Facial expression Hand gesture Fusion Model (CFHFM). CFHFM mines unstable sentiments with the help of Facial expression recognition system (Xpress-O) and Hand Gesture Recognition by Transformation (HGRT). Xpress-O and HGRT are defined in Chapter 4 and Chapter 6 respectively. The bi-modal fusion scheme incorporated to develop CFHFM is shown in Figure 7.1 of Chapter 7. RSDTs developed for linguistic nodes using temporal relations between set of images to track sentiment-based events. CBRFM utilizes these
Figure 9.1: System Overview for Mining Stable and Unstable Sentiments
temporal relations from RSDTs to develop a compact rule learner to achieve better recognition of unstable sentiments [237].

In this Chapter, we demonstrate the evaluations of unstable sentiments on three instances of RSDTs using CBRFM. Later, experiments are performed on datasets using CFHFM and CBRFM for estimating the recognition accuracy of unstable sentiments. The results are compared with traditional Association Rule Mining (ARM). Successively, elements of context are mined using CBRFM. Consequently, results of mining elements of context along with estimations of long term emotional state are presented in the tabulations. Results reveal that CBRFM developed using rough fuzzy approach achieves substantial increase in recognizing unstable sentiments using visual context.

Subsequent sections demonstrate experiments for estimating rating factors of unstable sentiments using CBRFM. RSDTs selected for evaluation include dataset ‘Raudra’, ‘Sringara’ and ‘Veera’. Dataset ‘Raudra’ represents narration of Scene I described in Appendix 9.1. The RSDT of dataset ‘Raudra’ is shown in Table 3.2 of Chapter 3. We name ‘Raudra’ for the respective dataset since raudra (anger) is the highlighted long term emotional state from the narration bestowed in Appendix 9.1. Likewise, we have developed 30 RSDTs to organize emotions and sentiments from respective narrations depicted in videos.

9.2 Experiment on RSDT of dataset ‘Raudra’ (Anger)

Every visual narration is processed initially by DFA-VAS with its formal notation defined in Section 8.3. Figure 9.2 illustrates linguistic nodes for dataset ‘Raudra’. Accordingly, the transition table for Raudra dataset is shown in Figure 9.3. The association of linguistic nodes represents the CBRFM annotations. The state diagram provides input to CBRFM for processing of linguistic nodes representing the narration individually. These delineations are prepared using originations from Figure 8.1, Figure 8.2 and Table 8.1 of Chapter 8. Referring Appendix 9.1 that describes Scene I, a denotes Lord Mamatha and b denotes Lord Shiva.
Figure 9.2: Linguistic nodes for Scene I [Refer Appendix 9.1]
Figure 9.3: DFA-VAS Representation for Dataset ‘Raudra’
Referring Figure 9.2 and semantic indices ($a$-values) provided in Table 3.1 of Chapter 3, rating factor of second node is estimated as $r = 1.4 \ (\geq 1.1)$. The rating factor is not estimated for the first node as it requires rating factor of previous node as referred in Eq. 8.7 of Chapter 8. Referring to Rule IV of Section 8.5 of Chapter 8, unstable sentiment evaluates to ‘distracted’ accordingly. The unstable sentiment ‘distracted’ belongs to Negative sentiment $N_s$ as defined in Section 8.5.1 of Chapter 8. Similarly, for third node, rating factor $r = 1.1 \ (\geq 1.1)$ that implies unstable sentiment ‘disappointed’. As seen in Figure 9.2, change in expression is not reflected in the last frame with respect to its preceding frame. A distinct process defines ‘$vyabhachari bhava$’ that suggests an action instead of a sentiment. Here, context information comprises facial expression related to ‘discharge of arrows’, as same hand gesture denotes attack as well as $Veera$ as referred in respective RSDT.

Certain issues are reflected while developing RSDTs. The first issue associates with rasas obtained from Xpress-O and hold certain repetitions. The entries with such repetitions are marked as italic in RSDTs since there exits multiple entries causing ambiguity in those expressions. The second issue relates to unstable sentiments that have entries with state of question marks. The former ambiguity is resolved by CFHFM, but the latter issue $x$ is untouched. However, both the issues are reduced by execution of RSDT using CBRFM for respective example. Value of expected $x$ concludes to unstable sentiment ‘disappointed’ from value of $x$ as ‘distracted’.

### 9.3 Experiment on RSDT of dataset ‘Veera’ (Heroic)

The next dataset includes dataset ‘Veera’ as shown in Figure 9.4. It represents linguistic nodes for Scene II described in Appendix 9.1. Scene II highlights heroic state of emotion for bequeath narration. Respective DFA-VAS representation for dataset ‘Veera’ is shown in Figure 9.5 where $a$ denotes Lord Ravana and $b$ denotes Lord Shiva. Likewise, as an onset of previous dataset, the evaluation of Scene II follows.
<table>
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<tr>
<th></th>
<th>Shanta</th>
<th>Gyan mudra</th>
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<tbody>
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<td>peace</td>
<td>Sringara</td>
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<tr>
<td></td>
<td>Meditation/prayer</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Sringara</th>
<th>Pataka</th>
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<tbody>
<tr>
<td>2</td>
<td>Prasanna by lord Shiva</td>
<td>saluting</td>
</tr>
<tr>
<td></td>
<td>Joy/ Possession</td>
<td>Contentment/ Sense of achievement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Veera</th>
<th>Kapota</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>pride</td>
<td>Hasya</td>
</tr>
<tr>
<td></td>
<td>Ferocious approach with inimical intension</td>
<td>Sense of achievement</td>
</tr>
</tbody>
</table>

Figure 9.4: Linguistic nodes for Scene II [Refer Appendix 9.1]
Figure 9.5: DFA-VAS Representation for Dataset ‘Veera’
The RSDT used for dataset 'Veera' is shown in Table 7.2 of Chapter 7. Using Eq. 8.7 of Chapter 8, rating factor \( r \) for second node is estimated to 0.7 (<1.1). Referring to Rule IV of Section 8.5 of Chapter 8, unstable sentiment evaluates to 'contentment/ sense of achievement'. These unstable sentiments belong to set of Positive Sentiment \( P_s \) defined in Section 8.5.1 of Chapter 8. Decision attribute of RSDT estimates positive sentiment and its reverse also implies the same for corresponding polarity of rating values for emotions. Subsequently, referring Rule V in Section 8.5.1 of Chapter 8, Sringara (0.3) and Veera (0.5) are added for next image. The value of \( r \) finalizes to 0.8 for respective node as shown in Table 9.2. The tabulation reveals estimations of Rule V. Rule V is selected for encountered dataset where unstable sentiment (decision attribute) relates to 'distraction'. But interchanging of rating values mentioned in the tabulation leads to negative sentiment and changes the significances of unstable sentiments. As a result, the interchanging of rating values is not allowed.

Finally, for the last image, hand gesture 'Kapota' commutates from RSDT using ontology-based framework as unstable sentiment 'ferocious'. As a result, unstable sentiment 'contentment/ sense of achievement' leads to decision attribute as 'cruelty'. Rasas and emotions (marked as italic) encounter repetitions. Similar to the prior dataset, both the issues have been solved using CBRFM and execution of RSDT evaluates value \( x \) from 'joy' to 'cruelty'.

9.4 Experiment on RSDT of dataset 'Sringara' (Affection)

Enduring section draws attention for sringara rasa on similar lines to evaluate CBRFM. Linguistic nodes are developed for dataset 'Sringara' as shown in Figure 9.6 using DFA-VAS. Dataset 'Sringara' represents Scene III of Appendix 9.1. The RSDT of dataset 'Sringara' are rendered in Table 9.3 (a) and Table 9.3 (b). There exists multiple rasas (outcomes) from Xpress-O; causing ambiguity in recognizing unstable sentiments to be recorded by RSDTs. The ambiguity caused due to multiple entries for initial node is resolved using CFHFM. Self-learning Decision Rule Algorithm (SDRA) obtains deterministic stable and
Table 9.2: Subset Demonstrations of Rule V

<table>
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<tr>
<th>Emotion of previous image $i$</th>
<th>$\alpha$-value($i$)</th>
<th>Emotion of current image $j$</th>
<th>$\alpha$-value($j$)</th>
<th>$i + j$</th>
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</thead>
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<tr>
<td>Sringara</td>
<td>0.3</td>
<td>Veera</td>
<td>0.5</td>
<td>0.8</td>
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<tr>
<td>Hasya</td>
<td>0.2</td>
<td>Karuna</td>
<td>0.6</td>
<td>0.8</td>
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<tr>
<td>Veera</td>
<td>0.5</td>
<td>Hasya</td>
<td>0.2</td>
<td>0.7</td>
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<td>Scene</td>
<td>Node 1</td>
<td>Node 2</td>
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<td>--------</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>McgasNrua (Mru-gah-shir-)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Arrival of Beloved (Krishna)</td>
<td>Sringara</td>
<td>Sringara</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calling the beloved</td>
<td>Delight/Affection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Shoka</td>
<td>Pataka</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retrieval of Krishna</td>
<td>Shoka</td>
<td>Raudra</td>
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<td>Recline/reject</td>
<td>Indignation</td>
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<td>3</td>
<td>Raudra</td>
<td>Sacyasya</td>
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<td>Krishna cajoles</td>
<td>Agitated</td>
<td>Shoka</td>
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<tr>
<td></td>
<td>Directing/ showing way</td>
<td>Disappointment</td>
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Figure 9.6: Linguistic nodes for Scene III [Refer Appendix 9.1]
Table 9.3 (a): RSDT for Dataset ‘Sringara’

<table>
<thead>
<tr>
<th>CONDITION ATTRIBUTES</th>
<th>DECISION ATTRIBUTE</th>
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<td>Hand Posture</td>
<td>Hasta Mudra</td>
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<td>Significances</td>
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<td>cheek</td>
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<td>bhishrata</td>
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<td>shanta</td>
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<td>place of residence</td>
<td>shanta</td>
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<tr>
<td>tete-a-tete</td>
<td>adbhuta</td>
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<td>shoka</td>
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<tr>
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<td>shanta</td>
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<td>massage of the feet</td>
<td>shanta</td>
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<td>stair</td>
<td>raudra/</td>
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<td>adhura</td>
<td>adhuta</td>
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<td>calling the beloved</td>
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<tr>
<td>roaming</td>
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<td>bored</td>
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### Table 9.3 (b): RSDT for Dataset ‘Sringara’

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<th>Rasa</th>
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<th>Additional context</th>
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unstable sentiments from initial node. SDRA is implemented using Sentiment Classification Rough Set-based System (SCRSS) incorporated in CFHFM. But similar to previous cases, the other nodes have several expressions related to same hasta mudra. For assistance, an extra feature of orientation aspect is added in RSDT of Sringara dataset as depicted in Table 9.3 (a) and Table 9.3 (b). The inclusion of orientation attribute in the RSDT minimizes relative issues. However, CBRFM confirms expected significance of bequeath hand gesture as Pataka.

9.5 Comparative Results for CFHFM and CBRFM

Facial Action Units (AUs) are suitable to describe richness of spontaneous facial behavior. Several anatomically possible facial expressions can be represented as combination of few dozens of AUs. As a result, DFA-VAS incorporates labeling schemes related to FACS and AU codes. Referring to definitions of $P_s$ and $N_s$ in Eq. 8.11 and Eq. 8.19 of Chapter 8, Table 9.4 and Table 9.5 report accuracies of CFHFM and CBRFM respectively. The estimations of accuracies are performed on the datasets depending upon positive sentiments $S_p$ and negative sentiments $S_n$ respectively. However, adbhuta rasa with a value 0.6 can represent positive as well as negative sentiments. As a result, adbhuta (emotion surprise) is included in both the subsequent tabulations.

Sensitivity and specificity of CBRFM is recorded for each dataset. Table 9.4 reflects comparative results based on accuracy for positive sentiments. Similarly, Table 9.5 intimates results for negative sentiments. For multi-class problem, relative sensitivity and specificity are computed for every class and average of each value is evaluated and subsequently reported. Results of CFHFM and CBRFM are compared with ARM and achieved substantial increase in accuracy of 12.3% from ARM to CBRFM. However, CFHFM acquires minor increase in accuracy of 0.01% for recognizing positive sentiments. However, accuracy is raised for negative sentiments by 15.9% as compared to ARM. However, CBRFM provides an increase of 8.48% with respect to CFHFM.
Table 9.4: Comparison of Accuracy for Positive Sentiments

<table>
<thead>
<tr>
<th>Dataset</th>
<th>ARM</th>
<th>CFHFM</th>
<th>CBRFM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accuracy</td>
<td>Accuracy</td>
<td>Accuracy</td>
</tr>
<tr>
<td>Dataset 1: <em>Shanta</em></td>
<td>0.683</td>
<td>0.823</td>
<td>0.807</td>
</tr>
<tr>
<td>Dataset 2: <em>Sringera</em></td>
<td>0.603</td>
<td>0.680</td>
<td>0.720</td>
</tr>
<tr>
<td>Dataset 3: <em>Hasya</em></td>
<td>0.743</td>
<td>0.851</td>
<td>0.863</td>
</tr>
<tr>
<td>Dataset 4: <em>Adbhuta</em></td>
<td>0.760</td>
<td>0.826</td>
<td>0.673</td>
</tr>
<tr>
<td>Dataset 5: <em>Veera</em></td>
<td>0.752</td>
<td>0.887</td>
<td>0.917</td>
</tr>
<tr>
<td>Dataset 6: <em>Karuna</em></td>
<td>0.713</td>
<td>0.715</td>
<td>0.807</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>0.675</td>
<td>0.797</td>
<td>0.798</td>
</tr>
<tr>
<td><strong>Std</strong></td>
<td>0.078</td>
<td>0.081</td>
<td>0.090</td>
</tr>
</tbody>
</table>
Table 9.5: Comparison of Accuracy for Negative Sentiments

<table>
<thead>
<tr>
<th>Dataset</th>
<th>ARM Accuracy</th>
<th>CFHFM Accuracy</th>
<th>CBRFM Accuracy</th>
<th>Specificity</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset 4: Adbhuta</td>
<td>0.657</td>
<td>0.715</td>
<td>0.768</td>
<td>0.882</td>
<td>0.783</td>
</tr>
<tr>
<td>Dataset 7: Shoka</td>
<td>0.774</td>
<td>0.742</td>
<td>0.938</td>
<td>0.563</td>
<td>0.915</td>
</tr>
<tr>
<td>Dataset 8: Bhayanaka</td>
<td>0.760</td>
<td>0.663</td>
<td>0.916</td>
<td>0.873</td>
<td>0.372</td>
</tr>
<tr>
<td>Dataset 9: Bibhatsa</td>
<td>0.571</td>
<td>0.902</td>
<td>0.771</td>
<td>0.952</td>
<td>0.685</td>
</tr>
<tr>
<td>Dataset 10: Raudra</td>
<td>0.774</td>
<td>0.885</td>
<td>0.938</td>
<td>0.563</td>
<td>0.915</td>
</tr>
<tr>
<td>Mean</td>
<td>0.707</td>
<td>0.781</td>
<td>0.8662</td>
<td>0.766</td>
<td>0.734</td>
</tr>
<tr>
<td>Std</td>
<td>0.091</td>
<td>0.106</td>
<td>0.121</td>
<td>0.189</td>
<td>0.224</td>
</tr>
</tbody>
</table>
Additionally, CBRFM accomplishes contextual elements from bestowed narrations along with substantial improvement in detecting unstable sentiments especially for positive polarity of expressions. The encountered achievement helps in perceptive narrations that can lead to solve various social issues.

### 9.5.1 Results for Mining Elements of Context

Likewise, experiments are performed on selected videos of Bharatanatyam dance actions to perform classification on elements of context. Weka machine learning platform is used to evaluate the rasas and hasta mudras present in the datasets. Contextual elements of scenes or narrations depicted by dance actions are estimated using Eq. 8.27 of Chapter 8. CBRFM achieves an average accuracy of 88.8% to mine elements of context as shown in Table 9.6. To evaluate annotation capabilities of CBRFM, statistical classifications are performed. It includes precision, recall and F-measure rates of semantics and sentics extraction process. These estimations are performed using corpus of topic and mood-tagged blogs from Live Journal (LJ), respectively.

One of the interesting features of website involving LJ bloggers allows the users to label required posts along with relative topic tags. These tags are associated with a mood label that decides more than 130 predefined moods [239]. Mood labels additionally develop custom mood themes and provide a good test-set for CBRFM. These mood labels and associated themes provide indications of affective status (optional) and mood-tagged posts. The mood-tagged posts reflect factual moods of the authors. However, LJ mood themes do not perfectly match the sentic levels. In consequence, we use a reduced set of 10 moods, specifically, ‘delight’, ‘happy’, ‘pensive’, ‘surprised’, ‘astonished’, ‘agitated’, ‘sad’, ‘angry’, ‘disappointed’, ‘scared’. The respective set of moods is associated with relevant metadata of SCRSS. Subsequently, SCRSS records semantics and sentics by DFA-VAS to relate topic and mood tags for estimating precision, recall and F-measure rates.

Inferences from semantics and context associated with each of the selected post achieve stable and unstable sentiments. In addition, these inferences provide
Table 9.6: Results for Mining Contextual Elements Using CBRFM

<table>
<thead>
<tr>
<th>Dataset</th>
<th>TP Rate</th>
<th>FP Rate</th>
<th>Precision</th>
<th>Recall</th>
<th>F-Score</th>
<th>ROC Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset 1: Shanta</td>
<td>0.833</td>
<td>0.011</td>
<td>0.909</td>
<td>0.833</td>
<td>0.870</td>
<td>0.911</td>
</tr>
<tr>
<td>Dataset 2: Sringara</td>
<td>1.000</td>
<td>0.024</td>
<td>0.875</td>
<td>1.000</td>
<td>0.933</td>
<td>0.988</td>
</tr>
<tr>
<td>Dataset 3: Hasya</td>
<td>0.846</td>
<td>0.047</td>
<td>0.733</td>
<td>0.846</td>
<td>0.786</td>
<td>0.900</td>
</tr>
<tr>
<td>Dataset 4: Adbhuta</td>
<td>1.000</td>
<td>0.011</td>
<td>0.917</td>
<td>1.000</td>
<td>0.957</td>
<td>0.994</td>
</tr>
<tr>
<td>Dataset 5: Veera</td>
<td>1.000</td>
<td>0.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Dataset 6: Karuna</td>
<td>0.846</td>
<td>0.000</td>
<td>1.000</td>
<td>0.846</td>
<td>0.917</td>
<td>0.923</td>
</tr>
<tr>
<td>Dataset 7: Shoka</td>
<td>0.750</td>
<td>0.011</td>
<td>0.875</td>
<td>0.750</td>
<td>0.800</td>
<td>0.870</td>
</tr>
<tr>
<td>Dataset 8: Bhayanka</td>
<td>0.917</td>
<td>0.000</td>
<td>1.000</td>
<td>0.917</td>
<td>0.957</td>
<td>0.958</td>
</tr>
<tr>
<td>Dataset 9: Bhibhatsa</td>
<td>0.750</td>
<td>0.022</td>
<td>0.750</td>
<td>0.750</td>
<td>0.750</td>
<td>0.864</td>
</tr>
<tr>
<td>Dataset 10: Raudra</td>
<td>1.000</td>
<td>0.011</td>
<td>0.750</td>
<td>1.000</td>
<td>0.957</td>
<td>0.958</td>
</tr>
</tbody>
</table>
significance of sentiments that are consecutively tagged with topic and mood labels. Comparisons are performed on encountered labels with corresponding topic and mood LJ tags. Consequently, CBRFM obtains substantial accuracy in terms of recognition related to semantics along with sentsics of bequeath image. Detection of moods, for instance ‘happy’ and ‘sad’ posts is identified with high precision of 89.2% and 85.3% respectively. Accepted recall rates are estimated as 76.5% and 72.9% as depicted in Table 9.7.

Certain frequently used conventional approaches for automatic identification of emotions in images and text are employed. The first approach includes keyword spotting that classifies endowed text into categories that base on presence of fairly unambiguous affect words. F-measures for keyword spotting algorithm are estimated as 53.7% for ‘happy’ posts and 51.4 % for ‘sad’ posts. The second approach utilizes lexical affinity that assigns arbitrary words to probabilistic affinity for conferred mood [240]. F-measure rates depict 63.2% and 58.1% for selected posts. Lastly, statistical methods involve estimations related to valence of keywords and word co-occurrence frequencies based on large training corpus. F-measure estimates to 69.5% and 62.9% for ‘happy’ and ‘sad’ posts, respectively [241]. Corresponding F-measure rates are estimated on same dataset by using traditional approaches with respect to CBRFM. Results reveal that CBRFM achieves significant increase of F-measure rates with 82.3% for ‘happy’ post and and 81.8% for ‘sad’ post.
<table>
<thead>
<tr>
<th>Long Term Emotional State (Mood)</th>
<th>Precision (%)</th>
<th>Recall (%)</th>
<th>F-measure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delight</td>
<td>64.211</td>
<td>52.219</td>
<td>57.536</td>
</tr>
<tr>
<td>Happy</td>
<td>89.232</td>
<td>76.543</td>
<td>82.338</td>
</tr>
<tr>
<td>Pensive</td>
<td>58.786</td>
<td>43.089</td>
<td>53.517</td>
</tr>
<tr>
<td>Surprised</td>
<td>71.491</td>
<td>68.711</td>
<td>74.574</td>
</tr>
<tr>
<td>Astonished</td>
<td>70.611</td>
<td>52.843</td>
<td>61.193</td>
</tr>
<tr>
<td>Agitated</td>
<td>85.323</td>
<td>72.971</td>
<td>81.829</td>
</tr>
<tr>
<td>Sad</td>
<td>81.417</td>
<td>53.337</td>
<td>64.448</td>
</tr>
<tr>
<td>Angry</td>
<td>76.896</td>
<td>59.463</td>
<td>66.727</td>
</tr>
<tr>
<td>Disappointed</td>
<td>69.343</td>
<td>60.500</td>
<td>71.892</td>
</tr>
<tr>
<td>Scared</td>
<td>59.927</td>
<td>49.124</td>
<td>52.330</td>
</tr>
</tbody>
</table>
9.6 Summary

Majority of work has been dealt with emotion detection, scene categorization or sentiment analysis at cognitive level. CBRFM tries to bridge the semantic gap between concept-based objects and context-based relations among scenes or narrations. CFHFM model accomplishes an increase in accuracy of 9.24% for excerpting stable sentiments. As a result, CHFHM is preferred over simple fusion for detecting emotions from images. Besides, CBRFM accelerates with success of 72% for unstable sentiments. The remarkable observation notes that rating factor associated to sentiments defines a mathematical constant. The rating factors estimated relates to the summation of two different lower $a$-value expressions. It proves positive in approximating sentiments in terms of mathematical expressions. These estimated rating factors can enhance advanced image processing in the benefit of automated emotion and sentiment-based applications. CBRFM also achieves success in better classification of universal emotions for stable as well as unstable sentiments along with positive and negative coarse grained sentiments. Temporal relations along with visual context are executed to analyze performances in state-of-the-art systems of Bharatanatyam dance narrations. CBRFM is able to identify reasons, actions and reactions of human behavior from social scene context. These elements of context are used to recognize long term emotional state from the bestowed narrations.
### Scenes or Narrations

<table>
<thead>
<tr>
<th>Scene</th>
<th>Long Term Emotional State highlighted in the dataset used</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Raudra (Anger)</td>
<td>Lord Shiva burns Manmatha to ashes. [Lord Shiva was mediating in the forest. His peace is disturbed by Lord Manmatha, the god of Affection. At first Shiva is pleasantly startled, but upon seeing the cause of the disturbance, engages in the dance of fury. Finally he burns Manmatha to ashes.]</td>
</tr>
<tr>
<td>II</td>
<td>Veera (Heroic)</td>
<td>Ravana undergoes meditation and worships Lord Shiva. Lord Shiva gets prasanna (happy) and blesses Ravana with some powers. In return Ravana salutes Lord Shiva but becomes cruel and uses his powers for demonic purposes.</td>
</tr>
<tr>
<td>III</td>
<td>Sringara (Delight/Affection)</td>
<td>Radha. Unyielding Radha shows Krishna his way out. [Radha waits for his beloved Krishna in anticipation. When Krishna arrives late, Radha’s delight turns into anger as finds marks of other women on him. When Radha confronts him, Krishna tries to cajole her. Unyielding Radha shows him his way out.]</td>
</tr>
</tbody>
</table>