Chapter 3

Dataset Creation

In this chapter a novel video dataset of ground exercises of Sattriya dance has been introduced. This dataset is created to validate any vision-based method for recognition of ground exercises of Sattriya dance.

The Sattriya Dance Ground Exercise dataset introduced in this chapter comprises of two datasets: a video dataset and the dataset with extracted features. The video dataset includes 560 videos of 28 ground exercises that are collected from twenty individuals. From each video, frames are extracted and silhouettes are generated accordingly. Here, all the frames of a video are not considered, only key frames are stored. The silhouettes are also stored in this dataset containing 560x30=16800 images. The feature dataset is generated using feature extraction methods includes three features, namely- height-width ratio of minimum bounding rectangle of each frame, inter-frame energy difference and inter-frame entropy difference. The features are described in the next chapter. An overview of developing the Sattriya dance ground exercise video dataset is presented in this chapter.

The organization of the rest of the chapter is as follows: The motivation of creating this dataset is marked in Section 3.1. Section 3.2 describes the related dynamic dance gesture dataset available in the literature. Section 3.3 describes about the process of developing the Sattriya dance ground exercise video dataset. The annotation of the ground exercise database

is presented in Section 3.4 to understand the meaning and usefulness of the ground exercises. Finally, the conclusion and future scope of the newly introduced dataset is presented in Section 3.5.

3.1 Motivation

Dance gesture recognition has many applications as in performance evaluation of dances [49], e-learning [100], dance form recognition [14], learning dance from online videos [19] etc. Several research works on dance gesture recognition of Indian classical dance from video are available in the literature. The major limitation of classifying dance gesture is availability of public dataset. For Indian Classical Dance, a few datasets are publicly available. A remarkable dataset [36] of static hand gestures of Sattriya dance is reported in the literature. However, any video dataset of Sattriya dance has not been found in the literature till date. Also, dance gesture recognition considering full body movement in this dance form is also not addressed yet. Ground exercises are the grammar of Sattriya dance, so these are necessary to store in video form. This has motivated to introduce a video dataset of Ground exercises of Sattriya dance considering full body movement for validation of dance gesture recognition methods. The Sattriya dance ground exercise video dataset has been created to develop a computer vision system to classify each ground exercise. As well as this dataset can be useful for benchmarking a variety of computer vision and machine learning methods designed for dynamic dance gesture recognition.

3.2 Sattriya Dance Ground Exercise Video Dataset

Ground exercises are the foundation for the learners of a classical dance form to make a healthy physical, mental and spiritual set-up that are necessary for a classical dancer. The ground exercises of Sattriya dance are also called Mati-Akhora, which is an Assamese term. Mati Akhora means exercises done on the ground [101]. These are the structural grammar systems to learn Sattriya dance. They include all the features of Sattriya dance i.e., the basic body positions, body bending, movements of eyes, neck, head, body, hand (hastas) and foot, various jumps, turns, gaits, etc. Some of these ground exercises are similar to certain yogic

postures or asanas based on yoga Shastra. The founder of Sattriya dance, Mahapurush Sankaradeva, was a great exponent of yoga, who had studied the Yoga Shastra thoroughly. Many ground exercises have yogic qualities that help the learners to shape their bodies as per requirement.

The total number of ground exercises of Sattriya dance differs from Sattras to Sattras. According to Karuna Borah, who is an expert in the field of Sattriya dance [17], there are 64 ground exercises mentioned in the book Sattriya Nrittyar Rup Darshan. The names of the ground exercises also may differ as some experts have identified these ground exercises on the basis of the movements of the hands, while some experts have emphasized their views in naming them as per the movements and the direction of the feet. However, the origin is the same.

The SDGE dataset includes 28 ground exercises that are easily performable by the dancers [101]. Some of these are used in Sattriya dance while some others are used merely as physical exercises. The ground exercises in the dataset have been recorded from some Sattriya dance training centres and Sattras of Assam.

The ground exercises have a standard dance sequence called ‘bajna’ performed with an instrument ‘khol’ specially used in classical songs and dances of Assam. The standard static postures of each ground exercise can be referred to as basic pose. The basic poses reflect the meaning of the ground exercises. The basic poses of all the 28 ground exercises are shown in Figure. 3.1.

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In this dataset we have included the commonly used ground exercises in Sattriya dance. The names of the ground exercises are- Athua, Bohi Muruka, Bohi Sata, Charitiya

Jalak, Etiya Sata, Gerua Sua, Haar Bhonga, Haat Bhori Salana, Haat Pokua, Jalak, Jatoni, Kati Sata, Ketela, Murupa, Ora Sata, Ora, Orat Boha Utha, Paani Sisa, Pada Salana, Pasala Tula, Salana, Sanmukholoi Sata, Satrawali, Singha Jalak, Sitika, Thiyo Muruka, Tintiya Jalak, and Udha Sata.

Figure 3.1: Basic poses of Ground Exercises

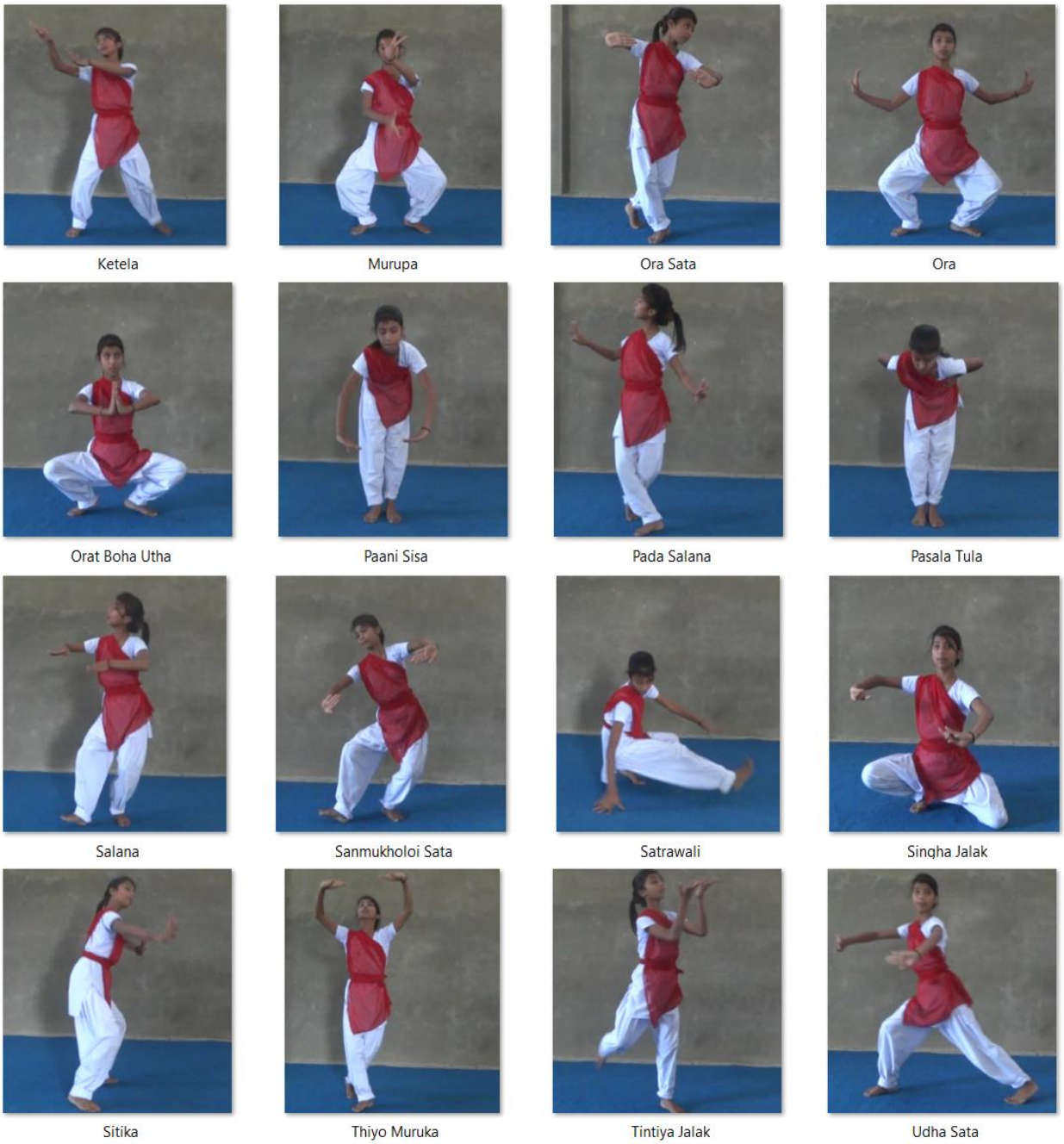

Figure 3.1: Basic poses of Ground Exercises (contd.)

3.2.1 Class Labels

There are 28 ground exercises in the dataset. The standard names of the ground exercises are used as class labels. The class labels in the dataset are listed with the numeric label in Table 3.1.

Table 3.1 Class labels of Ground Exercises in our Dataset

Label	Class Name	Label	Class Name
1	Athuwa	15	Ora (Purush and Prakriti)
2	Bohi Muruka	16	Ora sata
3	Boha sata	17	Orat boha utha
4	Charitiya Jalak	18	Pani Sisha
5	Etiya Sata	19	Pada Salana
6	Gerua Sua	20	Pasala Tola
7	Har Bhonga	21	Salana
8	Hat Bhori Salana	22	Sanmokhloi Sata
9	Hat Pokua	23	Satrawali
10	Jalak	24	Singha Jalak
11	Jatoni	25	Sitika
12	Kati Sata	26	Thiyo Muruka
13	Ketela	27	Tintiya Jalak
14	Murupa	28	Udha sata

3.2.2 The System Setup

The videos have been captured by means of a 13 Megapixel camera keeping at a fixed position. The motions of the dancers are captured under uniform background. Also, a fixed distance is maintained between the camera and the dancer. Finally, the videos are saved in

uncompressed ‘AVI’ file format. After background subtraction 2D silhouettes are extracted using vibe [8]. From the 2D silhouettes minimum bounding rectangles are obtained.

3.2.3 Framework

The proposed framework for the process of creating the dataset is presented in Figure 3.2. All the steps are described in the below subsections.

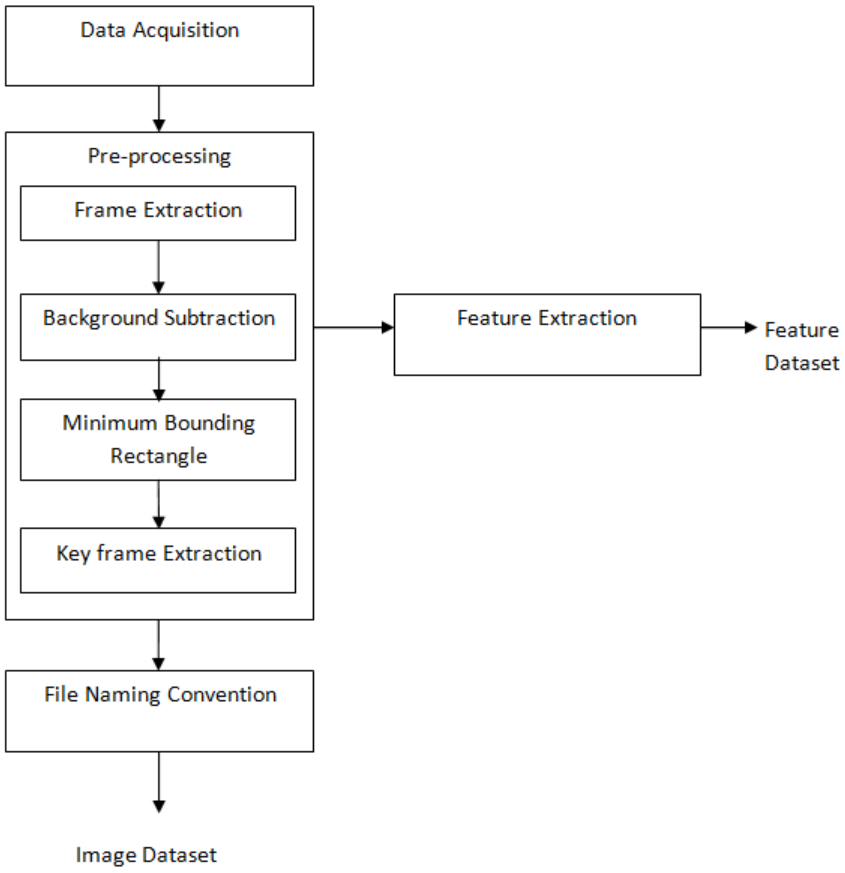

Figure 3.2: The Proposed Framework in Dataset Creation

3.2.4 Steps of Dataset Creation

In this section the major steps of creation of the Sattriya dance ground exercise dataset is explained. These are

- Data Acquisition
- Pre-processing
- File naming convention

3.2.4.1 Data Acquisition

The first phase is the data acquisition which refers to the collection of ground exercises of Sattriya dance from different dancers. To create this dataset 560 videos of 28 ground exercises have been recorded from 20 individuals. In this dataset each ground exercise is performed by 20 dancers.

3.2.4.2 Pre-processing

After data acquisition data are pre-processed. The process of pre-processing is described below.

1. **Frame Extraction:** At first the frames are extracted from the videos. The frames are converted to grey scale images. The number of frames in the videos ranges from 150-400. Figure 3.3 shows some frames of the ground exercise “Ora Sata”.

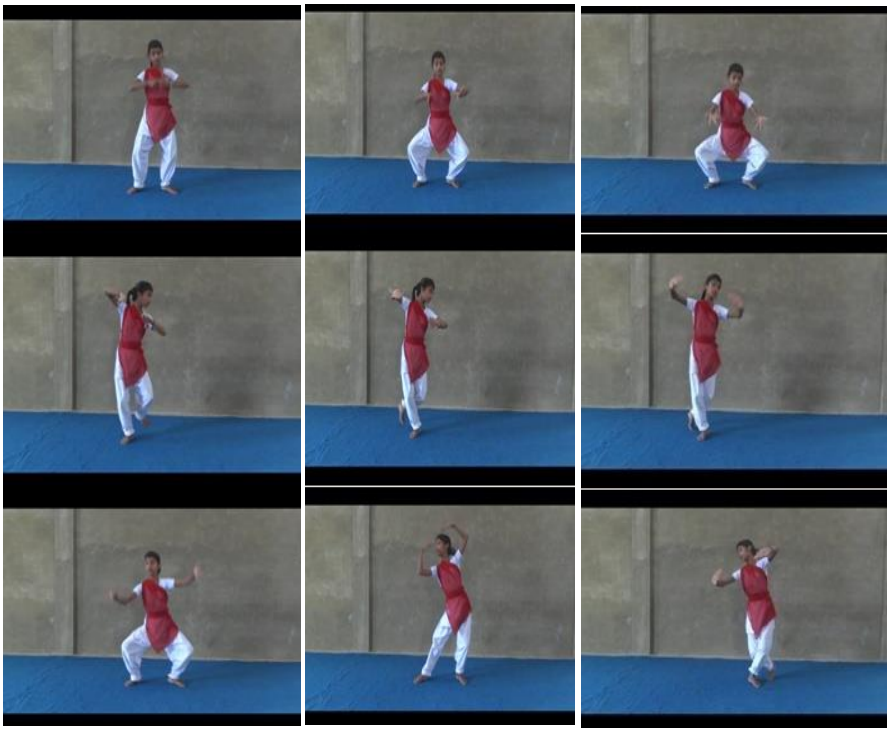

Figure 3.3: Some frames of the ground exercise “Ora Sata”

2. **Background subtraction:** It is a technique for separating out foreground elements from the background. Background subtraction technique is used for detecting dynamically moving objects from static cameras. Background subtraction is carried out using vibe [8] to get the 2D silhouettes. Figure 3.4 shows some frames of the ground exercise “Ora Sata” after background subtraction.

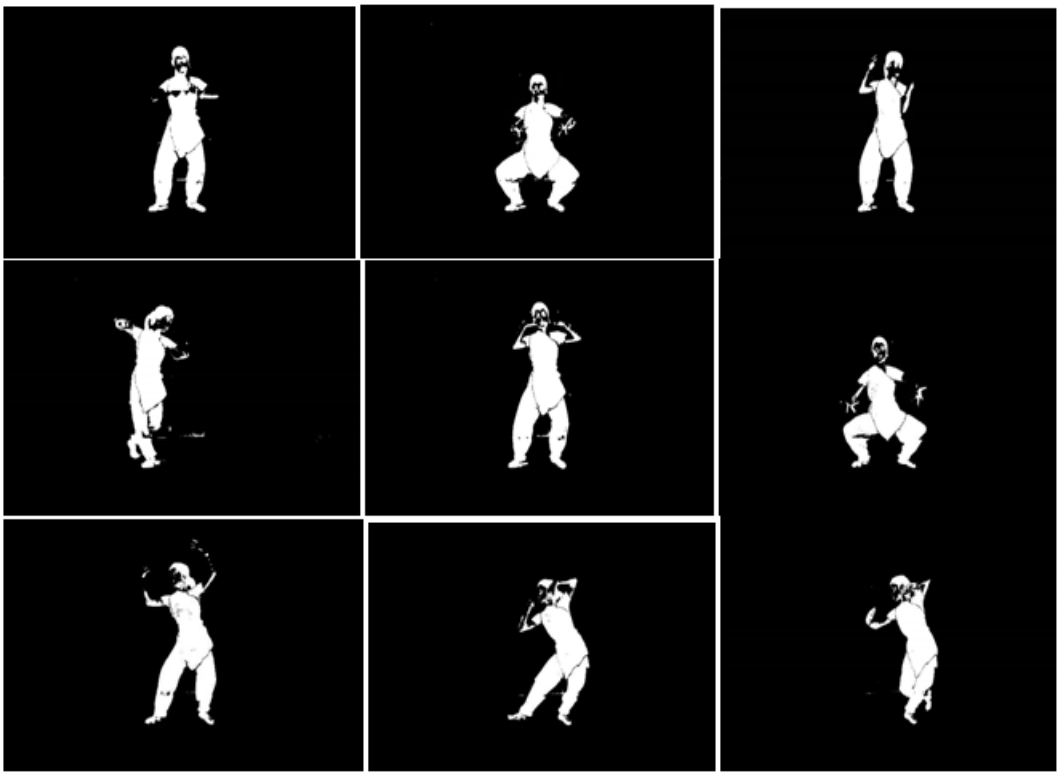

Figure 3.4: Some frames of the ground exercise “Ora Sata” after background subtraction

3. **Minimum Bounding Rectangle:** A minimum bounding rectangle (MBR) is used to approximate a complex shape. It is a rectangle whose sides are parallel to the x and y axes and minimally encloses the more complex shape. Here the MBR of each frame has been found out using Matlab function. Figure 3.5 shows MBRs of some frames of the ground exercise “Ora Sata”.

Figure 3.5: MBRs of some frames of the ground exercise “Ora Sata”

4. **Key frame Extraction:** Key frame extraction here is performed before feature extraction. Key frames are the characteristic frames of the video which render limited, but meaningful information about the content of the video [60]. Researchers have attempted to exploit the sundry features for extraction of key frames from videos. A key frame extraction algorithm is proposed to extract the key frames. Here in this work a method is proposed based on height to width ratio of the minimum bounding rectangle of all the image frames. Since we have used the HW of Minimum Bounding Rectangle as a feature, it would be helpful in finding the key frames.

Frames having same HW are considered redundant. The concept used in this algorithm is simple, but it gives quite satisfactory result.
The proposed algorithm is described briefly:

Key Frame Extraction Algorithm:

1. Finding the MBRs of all the image frames.
2. Finding the height: width ratio of all the MBRs.
3. Finding the difference of the ratio of two consecutive frames for all the MBRs.
4. Finding the average value of all the difference values and setting that value as threshold (T).
5. It is considered as a key frame when the difference is greater than T. If it is not so it is to be discarded.

3.2.4.3 File Naming Convention

We define a simple file naming convention for the original data and 2D silhouette data for user's convenience. From the file name the information such as gesture index, dancer index, type of image i.e., normal or silhouette image, frame number etc. can be obtained by the user. Here, all the frames of a video sequence are not considered, only key frames are stored. Moreover, the video sequences in uncompressed 'AVI' file format are also stored in the dataset separately. The basic poses of each gesture are also stored in the dataset. The file naming convention has been shown in the Figure 3.3.

G _ Di_F_T.Ext	
Symbol	Meaning
G	Name of Gesture/class
Di	Dancer index {1:20}
F	Frame number {0:30 - image data, dd – video data}
T	Data type {N-Normal, S-Silhouette}
Ext	File extension {PNG, AVI}
Example: Image data: *Ora*_D1_1_N.png Video data: *Ora*_D1_dd_N.avi	

Figure 3.6: File Naming Convention

3.3 Dataset Annotation

The annotated details of the ground exercises in our dataset are presented in Table 3.2.

Table 3.2: Dataset Description [101, 17, 43]

Sl. No	**Name of Mati Akhora / Ground Exercise**	**Where to Apply**	**Usefulness**
1	Athuwa	in dance	It loosens the joints of knee and waist.
2	Bohi Muruka	in dance	This exercise gives the stress on the thighs. Therefore, muscles are relaxed and toes and finger joints stiffness are reduced. This

			process makes the body ready for dancing.
3	Boha sata	in dance	Thigh muscles, lower back muscles and toes are relaxed after practicing this exercise. It strengthens the muscle movement in case of dance.
4	Charitiya Jalak	in dance	This is a good exercise for abdomen and head. It relaxes the thigh muscles.
5	Etiya Sata	in dance	It develops a distinct hand gesture fits with any kind of body shape.
6	Gerua Sua	as exercise, can be used in dance	It increases the strength of waist and thigh. It also helps in increasing the spinning capacity of head.
7	Har Bhonga	as exercise, can be used in dance	It loosens the joints of knee and waist.
8	Hat Bhori Salana	in dance	It helps in developing accuracy in both hand and foot work.
9	Hat Pokua	as exercise, can be used in dance	It is a hand exercise. It loosens the joints of hand and makes them ready for free movement.
10	Jalak	in dance	It helps in smooth movement of toe and fingers.
11	Jatoni	in dance	Thighs, arms and back are relaxed. The working ability of the body is increased.

12	Kati Sata	in dance	It develops a distinct hand gesture fits with any kind of body shape.
13	Ketela	in dance	This exercise is fruitful in balancing the whole body. It is a good exercise to enhance the beauty of a woman by helping the body healthy.
14	Murupa	in dance	This exercise helps in hand movement along with waist and thighs. It reduces thighs muscles.
15	Ora (Purush and Prakriti)	initial position in male and female style of dancing	Ora is the basic stance or initial position of Sattriya dance. This pose helps in relaxing spinal cord. It strengthens the muscles of spine, thigh, hand and arms.
16	Ora sata	in dance	It is a good exercise for spinal cord. It makes arms and waist accordingly for dance.
17	Orat boha utha	both exercise and dance	It strengthens thigh muscles.
18	Pani Sisha	as exercise, can be used in dance	It is a simple exercise for waist movement. Stomach aches and arm pains are cured by practicing this exercise.
19	Pada Salana	in dance	It develops the foot works in dance.
20	Pasala Tola	both exercise and dance	It is good for waist joints. It is a loosening exercise for neck and waist.

21	Salana	in dance	This is a good exercise for the movement of neck, head and eyes. It removes laziness from the body.
22	Sanmokhloi Sata	in dance	It strengthens the waist joints and increases the static energy of legs useful for dance.
23	Satrawali	both exercise and dance	The back side of the body works smoothly as the stress is on the arms when practicing it.
24	Singha Jalak	in dance	This exercise makes a dancer ready for dancing without stiffness using each part of the body. Along with dancing this exercise sharpens eye sight.
25	Sitika	in dance	Thigh, elbow and wrists are ready for dance after practicing this exercise.
26	Thiyo Muruka	in dance	After doing this exercise finger movement is disjoint. Arms are getting strong. It is helpful in back pain.
27	Tintiya Jalak	in dance	It is very essential for each and every part of legs and back side of the body. This exercise also helps in curing constipation problem.

28	Udha sata	in dance	This exercise is helpful for upper back, lower back and thigh. It helps the body to ready for dance.

3.4 Conclusion and Future Remarks

In this chapter a novel video dataset of ground exercises of Sattriya dance is introduced. The dataset consists of 560 videos of 28 ground exercises from twenty individuals. Moreover, by considering the key frames the dataset contains silhouette frames of 560x30=16800 images. Finally, the dataset comprises 560 videos and 16800 images. The purpose of creation of this dataset is to develop a computer vision system to classify the ground exercises of Sattriya dance. This dataset can also be useful for benchmarking a variety of computer vision and machine learning methods designed for dynamic dance gesture recognition. As the original videos are stored in the dataset, the number of key frames for a video can be increased or decreased as per application. Moreover, the SDGE dataset is generated using feature extraction methods explained in the next chapter. The effectiveness of the dataset is established by classifying the ground exercises in terms of classification accuracy using some well-known machine learning classifiers presented in the next chapter. A method is developed to improve the classification accuracy of the dynamic gestures of Sattriya dance that is discussed in the next chapter.

3.5 Acknowledgement

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