Unusual Activity and Anomaly Detection in Surveillance

A) Problem Statement

Definition:

Activity is a sequence of actions to accomplish a goal. Activity can be a group of consecutive action or tasks performed by an individual. Some of the activities such as wake up, look, sit down, eat, drink, leave, come, put up, put down, write etc., which belong to set of defined activities, known as Usual Activity. Any activity which is different from the defined set of activities is called as Unusual Activity.These unusual activities occur because of mental and physical discomfort.Unusual activity and anomaly detection is the process of identifying and detecting the activities which are different from actual or well-defined set of activities and attract human attention.

Challenges:

Although the research on unusual activity and anomaly detection is beneficiary and received a lot of attention from research community but it also faces some challenges that have bought with advances which are listed below:

1. Due to different motion patterns of different subjects at different time, the accuracy of activity recognition decreases.
2. Location sensitivity of wearable devices, sensors and smart phones in terms of orientation and position.
3. It is difficult for any classification algorithm to recognize the motion during the transition period between two activities.
4. Resource and Energy constraints
5. Smaller datasets

Scope:

Unusual activity and anomaly detection has its immense utilization in many areas which are related to find the unexpected activities or variations in normal patterns of activities so that appropriate actions in against can take place on time. Unusual activity and anomaly detection can have great implications in various fields with some useful applications which are listed below:

1) Security related applications such as Defence, Military, checking at airports.
2) Healthcare, Visual Surveillance through Content Based Retrieval
3) Network Security Threat Detection
4) Assisting the sick and disabled patients
5) Location based Services
6) Home based rehabilitation
7) For Ambient Assisted Living Environment

B) Background

Unusual human activity detection has emerged from a widely researched area of Activity Recognition. Previously, many researches have deployed and used various methodologies and approaches for recognition of unusual anomalies and activities such as Motion Influence maps, temporal differencing, Gaussian distribution, motion segmentation, space-time approach, sequential approach, syntactic based,sensor-based, vision-based, description-based approach, statistical based approach etc. Many approaches have been developed for detection of unusual anomaly and activities with the help of characteristics of motion of human such as direction of movement, motion speed, size of objects and subjects, interactions of objects withinframes ofsequences.

C) Methodology

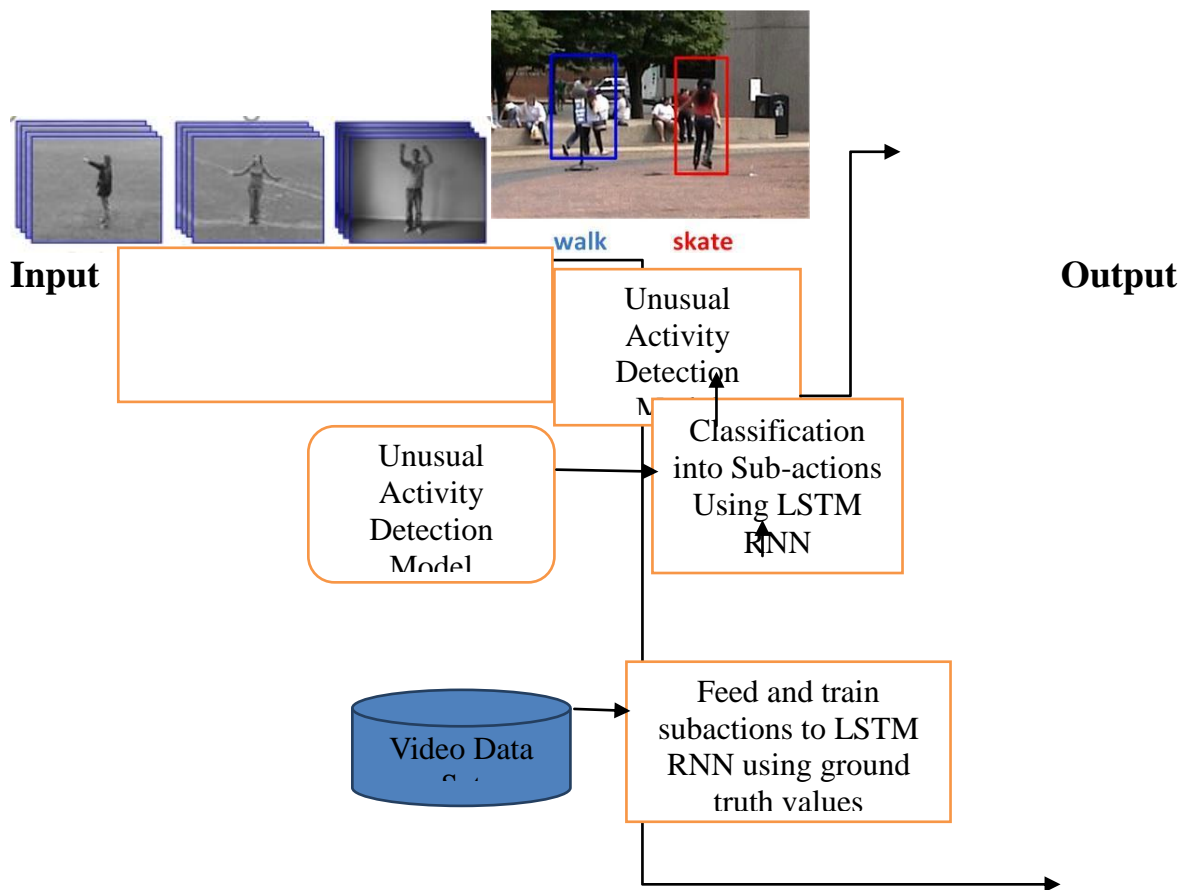The architecture diagram for unusual Activity and anomaly detection in surveillance is shown in figure 1.

Figure1: Architecture Diagram for Unusual Activity& Anomaly Detection

The above architecture diagram shows how this project will detect unusual human activity and anomaly in surveillance using the popular methodology of LSTM RNN i.e. Long Short-term Memory Recurrent Neural Network which will include video dataset collection for activity recognition, n number of frames will be extracted to define individual actions. Afterwards a unit of time will be assigned to each action to classify those actions into sub-actions and these sub-actions will be fed to LSTM RNN and train LSTM RNN using ground truth values of actions and then model will be tested against new activity video dataset and classification will be performed to classify an activity as usual or unusual activity.

D) Experimental Design

Datasets:

1. KTH dataset (http://www.nada.kth.se/cvap/actions/)
2. Weizmann Dataset (cs.utexas.edu/~chaoyeh/web_action_data/dataset_list.html)
3. UCF -Sports Dataset (cs.utexas.edu/~chaoyeh/web_action_data/dataset_list.html)
4. TREC Video Retrieval Evaluation (TRECVid) dataset
5. VIRAT dataset based on continuous visual event recognition (www.viratdata.org)
6. Performance Evaluation Tracking and Surveillance (PETS) dataset

Evaluation Measures:

Measures in terms of model performance such as Accuracy with varying number of epochs of classification LSTM RNN model, accuracy with or without dropout, accuracy with varying number of nodes and layers etc. will be computed by comparing with the detected unusual human activity and anomaly and ground truth values from the datasets

Software and Hardware Requirements:

The following are likely used technologies for the proposed work to solve the proposed problem:

1. OpenCV library which provides real-time computer vision and machine learning software library.
2. Python that is an efficient and debugging programming language.