1 Introduction

Shooting smooth video is not an easy task even for professionals because cameras cannot always be fixed or mounted on complicated and expensive electro-mechanical stabilized platforms. You may have to shoot again and again to get somewhat steady videos. However there are times you do not have chances to shoot your footages again; and even if you can shoot them again, it'll cost time. There are certain video capturing devices that are not intended to be mounted on stabilized platforms such as mobile phones, hand held devices where unwanted movements are always possible.

Video stabilization is an important video enhancement technology which aims at removing such annoying unwanted motion from videos. It plays an important role in many vision applications such as filming activities, video compression, tracking object movements etc. It also augments its importance with the increasing popularity of consumer video cameras, visual multimedia applications and various emerging digital video based technologies. Mass popularity of camcorders at present has increased the necessity of a good video stabilization method which can be used by an ordinary user.

Unwanted movements taking place during capturing process can be removed using either hardware or software based image processing approaches.

The first approach, called optical stabilization, consists of implementing an optical system that compensates for unwanted camera motion using motion sensors and active optical system. This approach is potentially the most powerful, but makes video cameras significantly more expensive and, therefore, is not chosen for a broad class of devices. The main advantage of this technique is that capturing device can get information on camera movements which can be used as an input to the noise filtering device. However this approach can remove the noise only up to certain extent and also do not provide the user any control over the kind of movements to be removed from the video.

The second approach, which is the focus of this research activity, consists in performing post-processing of the video sequence to eliminate unwanted motion in the video (swings) caused by a person holding the camera or mechanical vibration.

A major problem of current general purpose software video stabilizers is removal of some of the desired motions or leaving undesirable motions in video streams because of the incapability in determining what to be considered as wanted/unwanted. This dissertation proposes a practical software based solution for video stabilization that address this by providing a better control over to the user to modify the system determined level of jitter as user wishes by using few user parameters before generating the stabilized video output.

This has been achieved by providing a comprehensive graph outputs that is capable of providing an ordinary user an idea about the actual movements in the video helping him/her determine which movements are undesirable. User can view the motion of actual video and the corresponding graph on estimated output video constructed based on parameter values(this is before the output video generation) for comparison which enables him to determine the parameters to be changed to get expected video output. System initially suggests jitter to be removed automatically and allows the user to modify it with very few parameters to reduce the complexity.

In addition, some existing solutions are not properly handling the missing image areas appearing in the stabilized video due to the compensation of the motion. This research addresses it by constructing image by accumulating neighboring frames to fill up the missing image areas. Even though the proposed methodology does not provide real time processing, it is capable of providing an output within an acceptable time period. The solution is designed to cater for broader video stabilization requirements with reasonable quality output that can be determined by few user configurable parameters. This has been achieved using non-linear regression analysis base algorithm in iterative manner to remove horizontal and vertical undesirable movements.

The main contributions of this research work are

- Propose a Regression analysis and Optical flow based algorithm for video stabilization that can produce a full frame video output acceptable for most of general purpose video stabilization tasks.

- Provide an ordinary user a way to sensibly modify the jitter level according to user requirement that system has initially suggested in its automated estimation process.

In general the solution serves its objectives with certain limitations in the algorithm which can be further enhanced in future.

The rest of this dissertation is organized as follows. Various existing research work and related issues are discussed under 'Literature Survey'. Chapter 3- 'Stabilization Scheme' discusses overall methodology used in the project in detail with basis for each algorithm. The implementation of the algorithm into a workable system is described in Chapter 'Software base Implementation'. Chapter 6 details the experimental results based on the prototype implementation and chapter 7 concludes the work.

Appendix (A) outline the Pyramid based Lucas-Kanade Optical Flow algorithm and Appendix (B) explains about the contents of the CD-ROM supplied with the thesis.