1 Statement of the problem

The main objective of the project is to understand panic driven motion of people under different conditions. We aim to understand the problem by modeling the motion of a panic driven group which tends to make rash collective decisions and possibly come up with strategic solutions to minimize the trouble caused due to panic related rush. We use real-world information by analyzing YouTube videos and calculating velocities of people in such situations.

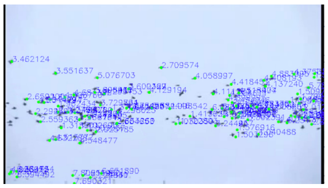
2 Literature Survey

One of the most disastrous forms of collective human behaviour is the kind of crowd stampede induced by panic, often leading to fatalities as people are crushed or trampled.

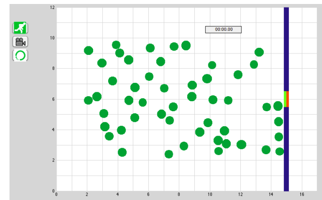
As pointed out in **Keating, J. P.** ***The myth of panic. Fire J. 5761, 147 (May 1982).*** destructive panic behaviour has been triggered in life-threatening situations such as fires in crowded buildings. This article also points out panicking individuals tend to show maladaptive and relentless mass behaviour like jamming and life-threatening overcrowding which has often been attributed to social contagion. The characteristic features of collective panic drive motion studied in socio-psycological studies such as **Mintz, A.** ***"Non-adaptive group behavior. J. Social Psychol. 46, 150159 (1951)*"** and **Kelley, H. H., Condry, J. C. Jr, Dahlke, A. E. Hill, A. H.** ***Collective behavior in a simulated panic situation. J. Exp. Social Psychol. 1, 2054 (1965).*** along with systematic quantitive theories can be summarized as: 1.People move or try to move considerably faster than normal. 2.Individuals start pushing, and interactions among people become physical in nature. 3.Moving and, in particular, passing of a bottleneck becomes uncoordinated. 4.At exits, arching and clogging are observed. 5.Jams build up. The physical interactions in the jammed crowd add up and cause dangerous pressures up to 4,450 Nm-1 which can bend steel barriers or push down brick walls. 6.Escape is further slowed by fallen or injured people acting as 'obstacles'. 7.People show a tendency towards collective behavior. 8.Alternative exits are often overlooked or not efficiently used in escape situations. **Helbing, Dirk, Illés Farkas, and Tamas Vicsek. "Simulating dynamical features of escape panic." Nature 407.6803 (2000): 487-490.** model the collective phenomenon of escape panic in the framework of self-driven many-particle systems. Their crowd dynamics are based on a force model. They model physical and psychological forces between particles and walls using mathematical equations which we use as a starting point for our simulations.

3 Work done so far

We have successfully implemented a program using C++ and OpenCV library which takes in a video and calculates the optical flow or the velocity with which



(a) Calculating the velocties of the birds



(b) Screenshot from the simulation code

Figure 1: Work done so far

the objects are moving in the video. This would allow us to simulate real world situations with our model.

Lucas Kanade algorithm with image pyramids [2] has been used for calculating the optical flow which yields velocities which have accuracy upto fraction of pixels. Here are some of the results (Fig.1 (a)).

On executing the program, we can either select click on a point to track, or automatically initialize points to track everything that is moving. The program also outputs the corresponding velocities of the feature points(shown as green circles in Fig 1. (a)). It also has the option to clear and re-initialize all the points while the video is running.

We have also managed to reproduce results from Dirk Helbing et al. [1] which involve single exits. This code has been written in MATLAB with a graphical user interface that enables an intuitive and fast handling of the features. Fig b) shows a snap of the simulator.

4 Tentative Work Plan

We plan to study the panic behaviour for different configurations of the arena, varying parameters such as number of exits, structure of the room, number of walls, placement of the walls, number of pedestrians ,mass distribution of type of pedestrians, velocity distribution of the pedestrians etc.

Once, we have understood and simulated the effect under various conditions we will apply our learnings to prevent real life accidents by proposing strategic solutions.

5 Main References

[1]. **Helbing, Dirk, Illés Farkas, and Tamas Vicsek.** *"Simulating dynamical features of escape panic." Nature 407.6803 (2000): 487-490.* [2]. **Baker, Simon, and Iain Matthews.** *"Lucas-kanade 20 years on: A unifying framework." International journal of computer vision 56.3 (2004): 221-255.*