

# Making teeming masses predictable

December 12 2016, by Marion De Boo

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Once every three years, millions of Hindus gather for the Kumbh Mela, the biggest religious festival in the world. This spring, 60 to 80 million pilgrims travelled to the banks of the Shipra river, at the holy city of Ujjain, in central India. On the busiest days, as many as 60 million people were moving around the festival site, which covers an area of thirty square kilometres.

For believers, the Kumbh Mela is an important moment in their lives. However, taking part in such a huge gathering of people also involves an element of risk, as anyone who stumbles and falls will be trampled to death. For Peter Sloot and Mike Lees, both computational scientists at the University of Amsterdam, this aspect of the festival presented an excellent opportunity for field research. Together with Indian, Russian, Swiss and Singaporean scientists, they set out to determine whether it is possible to predict when and how a slowly moving mass of people will suddenly panic and stampede, and whether that can be avoided by timely intervention.

Their project is partly financed by the Netherlands Organisation for Scientific Research (NWO), in the context of the Dutch-Indian IT research programme.

During the Kumbh Mela, the team set up camp on the muddy banks of the Shipra. There, they were able to personally experience the full effect of [crowd behaviour](#). Prof. Sloot explained that 'We had set up our research camp right in the middle of that huge crowd'. 'At times, amid all the pushing and shoving, we were totally focused on just trying to

survive. One time I thought 'If I stumble now, I'm done for!'

Scientifically, too, the researchers' task was anything but simple. A crowd is a complex system, and predicting the [collective behaviour](#) of such huge numbers of people is virtually unexplored territory. Therefore, the team recorded how individuals behave relative to one another, at increasing crowd densities. To this end, they used mobile phones, drones, camera surveillance via closed-circuit TV, as well as cameras mounted on hot air balloons. In addition, thousands of pilgrims were given specially designed electronic armbands, which were in constant contact with each other. This enabled the researchers to record how close the individual pilgrims came to one another, and how long they stayed in contact with each other.

The data they gathered will be used to develop computer models that can be used to simulate the behaviour of crowds. How do individual decisions affect collective behaviour? When and how does panic arise? The researchers hope that, ultimately, an improved understanding of these issues will enable them to develop computer models and algorithms that trigger an alarm system in good time, when danger threatens. In due course, such crowd management systems will help to make the Kumbh Mela, and other major events, a lot safer.

Provided by Netherlands Organisation for Scientific Research (NWO)

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