A method for online incremental mining of activity patterns from the surveillance video stream is presented in this paper. The framework consists of a learning block in which Dirichlet process mixture model is employed for the incremental clustering of trajectories. Stochastic trajectory pattern models are formed using the Gaussian process regression of the corresponding flow functions. Moreover, a sequential Monte Carlo method based on Rao-Blackwellized particle filter is proposed for tracking and online classification as well as the detection of abnormality during the observation of an object. Experimental results on real surveillance video data are provided to show the performance of the proposed algorithm in different tasks of trajectory clustering, classification, and abnormality detection.