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# Chapter 1

# INTRODUCTION

## 1.1 Introduction

Crowding is a common phenomenon observed during major events such as concerts, festivals, sports, games, and entertainment. One of the most interesting and active research topic in computer vision is the analysis of crowd behavior. Crowd is a group of people gathered in a certain location. Crowd differs in different situations like crowd in a temple will be different from the crowd in a shopping area. Crowd is a group of individuals sharing a common physical location. Now a day's increase in human population tends to increase the crowd in public areas [3].Thus it is required to analyze the surveillance system with several closed circuit Television is used to monitor the crowd. The human eye cannot observe all the cameras simultaneously. Thus an automated technique must be used for continuously monitoring the crowd for a long period. Challenging problems in detecting the desired events automatically are that, simultaneous occurrence of more than one events, large number of data must be processed, occlusions and real time detection. The proposed method can be applied from small group of object. The Internet of Things is a powerful industrial system of radio-frequency identification and wireless devices that have the ability to transfer data over a network without needing human interaction [1]. Analysis of a crowd behavior using surveillance videos is an important issue for public security, as it allows detection of dangerous crowds and where they are headed. [4] Computer vision based crowd analysis algorithms can be divided into three groups people counting, people tracking and crowd behavior analysis. Mainly, IoT consists of three layers, the sensing layer to gather data from real world via existing hardware e.g. sensors, next the network layer to transfer the collected data over wired or wireless network, and the application layer which is responsible for twoway communication between user and systems.

# Chapter 2
# LITERATURE REVIEW

**S. Hashish, and M. Ahmed (2015). "Efficient wireless sensor network rings overlay for crowd management in Arafat area of Makkah." In 2015 IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems, pp. 1-6.** Researchers have started utilizing sensor enabled Smartphones as a tag for large scale human sensing. With the increasing usage of Smartphones, more persons can be tracked without providing any tag in future. Some of the Smartphone based location tracking systems require an application to be installed on the client's Smartphone. The installed application obtains the location using GPS sensor of Smartphone and continuously updates the location to the remote server using Internet connection. However, it is rare that users in the large crowd and in remote locations will have the Internet connection all the time. There are many operating systems and versions for Smartphones, which makes the development and distribution of application a difficult task. By embracing the Smart City paradigm, crowd sensing becomes a solution able to cope with air pollution monitoring since this novel paradigm assumes that a significant number of users perform collaborative sensing tasks, thereby collecting data from different populated locations while doing their daily activities. The collected data is periodically transmitted to a central server for data storage and processing.

**D. C. Duives, T. van Oijen, and S. P. Hoogendoorn (2020), "Enhancing crowd monitoring system functionality through data fusion: Estimating flow rate from Wi-Fi traces and automated counting system data," IEEE Sensors, vol. 20, no. 21, p. 6032.**

With the development of sensor technology, communication technology, and big data science, smart city-oriented intelligent applications have become important services in human life. People's living standard has increased with improved infrastructure and intelligent applications such as smart home furnishing, smart building. With the increasing expansion and prosperity of urban business zones, some people choose to go shopping and seek entertainment in business zones. These large central business zones have become representative of the city image and are the zones with the most economic vitality. Besides,of people. By estimating the number of people, the degree of crowd gathering can be judged for accurate and effective management and planning at a monitored site. Traditional crowd monitoring systems depend on vision-based monitoring technology, the most commonly used method of which is closed-circuit television monitoring. In other words, the signal can be transmitted from the data source to a prearranged specific broadcast device connected to the source.Data fusion is a kind of information fusion technology that associates, correlates, and combines the information from multiple sensor to obtain more timely and accurate decision making support. From low-level data collection to high level services, data fusion offers feasible and high-efficiency support for deep fusion and mining massive multi-source data in heterogeneous networks

**Sebastian Bek and Eduardo Monari (2015), "The Crowd Congestion Level A New Measure For Risk Assessment In Video Based Crowd Monitoring", International Journal of Information Technology and Decision Making 3(4):2353- 2361.**

There are more categories of crowd counting in video sensing, one is region of interest counting which estimates the total number of people that regions at an instance and the other is line of interest which counts number of people who crosses a detecting line in an instance. The line of interest counting can be developed using feature tracking techniques where they are either calculated into trajectories and these trajectories are clubbed into object tracks or based on counting crowd densities from a temporal frame of the video.People in a crowded scene should be regarded as endangered in case in a certain local region of the scene a too large number of people is observed. However, on one hand absolute density is very difficult to extract from crowd videos, and on the other hand density alone is not a sufficient characteristic figure, since for example in a concert or public festival, a very high density is usual and not critical per se. We observed that even in scenarios with high people density, the situation can be regarded as non-critical, in case people can still move freely and smoothly through the crowd. As a consequence, we believe that information on the flow dynamics should be taken into account for risk assessment. Our approach assumes, that a local spot in the crowd might be critical, if the density is continuously increasing over time, and simultaneously a significant reduction of motion dynamics is observed.

**Rosario Fedele and Massimo Merenda (2017), "An IoT System for Social Distancing and Emergency Management in Smart Cities Using Multi-Sensor Data", In 2017 IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems.**

Recommender systems technology aims at reducing the consumer over-choice due to the huge amount of information available on the web. These systems use information gathered through few interactions with its user, to create a customized selection of items that can interest the user and can facilitate a better user experience. Recommender systems could be further improved if Machine Learning and Deep Learning algorithms were used for information retrieval. Noteworthy applications of recommender systems in smart cities include, a mobile IoT recommender system for users that need to find Park-and-Ride infrastructures to switch from a private to a public transportation mode, an autonomous situation-aware evacuation route recommenderarchitecture, optimized in real time, to obtain smart buildings, reuse data generated by various IoT applications, and adapt the services provided by the single IoT system, to improve the user experience. Traditionally, the problems above can be solved using

Shortest Path Finding algorithms that belong to the mathematical field of Combinatorial Optimization. Noteworthy examples are, Prim's algorithm, which can be used to derive the Minimum Spanning Tree and the Dijkstra's and the A* algorithms, which allow one to derive the shortest path between two points. In the Matlab environment, it is possible to find different tools that allow one to solve this problem.

**Marwa F. Mohamed, Abd El Rahman Shabayek, Mahmoud ElGayyar (2018), "IoT-based Framework for Crowd Management", Computer Science Department, Faculty of Computes and Informatics Suez Canal University, Ismailia, Egypt, IEEE International Conference on IoT.**

The Internet of Things is a powerful industrial system of radio-frequency identificationand wireless devices that have the ability to transfer data over a network without needing human interaction. Mainly, IoT consists of three layers, the sensing layer to gather data from real world via existing hardware, the network layer to transfer the collected data over wired or wireless network, and the application layer which is responsible for two way communication between user and systems. IoT applications are rapidly evolving and growing in various fields. Sensing the crowd by normal sensors and managing it is a challenging problem. Crowd management requires several stages including crowd data acquisition via sensor layers, data transferring via network layers, data analysis for decision making and applying crowd control measures via application layer. Using different sensor devices, it is possible to gather information about visitor's crowds and determine which areas are overcrowded. This information is then transmitted to the management layer where the admin can decide to close some doors and roads. The management layer shall be equipped by a smart service that can recommend which doors to be opened or closed to direct the crowd flow. The admins then decide whether to publish this information to the public or not. In order to increase the user end application usability, the application provides different languages and auser friendly interface.

# Chapter-3

## 1.2 Aim of the Project

The aim of this project is to detect and react to overcrowding issues at an early stage. This will help us to assess how effective our crowd safety precaution is and the considerations which are looked into are as follows, monitoring the overall number of people to ensure the safe venue capacity is not exceeded, monitoring the distribution of people to help prevent local overcrowding, identifying potential crowd problems to prevent the escalation of public disorder.

## 1.2 Project Domain

Our project come under the domain of Computer Vision where we have used both technologies to identify overcrowded areas. The Internet of things describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

Computer vision is an interdisciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

## 1.4 Scope of the Project

With booming in population and huge number of crowds converging at common places for meetings, gatherings, and reunions there is increased scope for these kind of projects. Our approach of identifying crowd in open space will be definitely useful in controlling the crowds in the public area, that too in this pandemic world crisis the importance of these kinds of projects have created necessary need among the governments of various countries to monitor the public crowd.

## 1.5 Methodology

### Image Processing Method

This method is software oriented approach which is used in open space i.e. malls, public areas and others, we used the technology of computer vision to detect the people with the help of cameras in public area, the input to