Crowd Management in Urban Areas Using Data and AI Algorithms

Karri Varun

Student, Rajam, Vizianagaram, 532127, India.

ABSTRACT

Data analysis, which is a branch of Data science is a method in which data is collected and organized so that one can derive helpful information from it. There are different ways of observing the behavior of data i.e., collecting the data, taking surveys from people etc. In this paper we try to study urban data to achieve crowd management so that the areas will be well organized without human intervention which results in less errors caused by manual crowd management. To Achieve this we use data available like the transport facilities , their need from the area etc. Crowd management can also be used for city planning and city development in lesser time when compared to manual city planning where we can also take public interests into account. Some crowded events can happen spontaneously, like a political rally or a protest march or a funeral procession. Controlling spontaneous crowded events, sort of a protest march, political rally, celebration after a sporting event, or concert, are often quite difficult. We will try to check what can we do with this project to overcome these situations by tracking the areas using AI and data analysis. We will also review some events which happened in the past and taking them as examples, we will study to apply algorithms like real time analysis, k fold cross evaluation, nested cross evaluation etc to validate the crowd density of those particular events.

Keywords:Analysis, Crowd management, Urban data, Algorithms,Validations

1. Introduction

Crowd management is the organized planning and the direction given to the orderly progress of events where large groups of people gather together. Crowd management and crowd control are two words which are theoretically same but different in application. Crowd management refers to the set of measures that must be taken to facilitate the movement and enjoyment of people, whereas Crowd control refers to the actions taken when a crowd of people behaves differently from what is expected. The main objective of crowd management is to ensure that a large amount of gatherings of people are controlled in an orderly manner without any disturbances. According to a study from United Nations, 68% of the people move to urban areas to maintain livelihood, as most of the facilities are available in the urban areas. So it is natural tendency that crowds gatherings happen more in some situations. . There are different scales of crowd gatherings for special events such as theater performance, concerts, music festivals, religious events, etc. These events hide serious potential safety hazards and crowd management challenges, including stampedes, abnormal behaviors [3], and abnormal incidents (adverse weather, poisonous gas, and explosions). Once an emergency happens where crowds are gathered, risks are enlarged. This is the point of time where the need of crowd management comes into place.

In this context ,we have mainly focused on how to use data to study crowd behavior,apply AI algorithms like K cross validation, Nested cross Algorithm etc.. to arrangeand extract useful information and thereby imposing the instructions physically to achieve crowd management. There are two fundamental building blocks are urbansensing and concrete data analytics Urban sensing allows us to obtain data from thecyber-physical world, and concrete data analytics to understand the city dynamics.

Overview of urban data: Urban data refers to the set of knowledge generated by many sources within the urban environment. during this section, we describe a number of the urban data Which is adequate enough to review those urban areas and crowd behavior.

These are:

- Cellular records
- Social media records.
- Transportation records

2. Literature Survey

In paper [1]Logesh Rajendran, R Shyam Sankaran mainly focused on crowd surveillance and crowd analysis using data analysis, specifically by AI. This paper also discussed about traditional methods of crowd management like CCTV surveillance and also some of the frameworks like video surveillance system management system, real time analysis processing system and integrated command & control system. This paper discussed the real time analytics processing system framework because it means mainly focuses on data and artificial intelligence. This paper also analyzed some of the famous pilgrimage trips like Kumbh mela, hajj with the help of video surveillance system, and since video surveillance system is caused by human

involvements, it also analyzed crowd data with Neural network and CSRNet with VGG-16 as front end.

In paper [2]Clayson Celes, Azzedine Boukerche and Antonio L F Loureiromainly focuses on explaining the way data can help us to handle crowd in urban areas and also there are some cases from which we can study how data analytics works in analyzing crowd behavior. It also points out what are the key challenges mainly a data analyst take they wanted to achieve crowd management in an organized way. This paper discusses the basic data analytics of achieving crowd management and also the cases where we can study how data affects crowd and can help us in achieving crowd management.

In paper [3] Xianzhi Li , Qiao Yu , Bander Al Zahrani ,Ahmed Barnawi , Ahmed Alhindi , Daniyal Alghazzawi,and Yiming Miaoclassifies the commonly used fusion technologies and gives practical use cases from the algorithm process to the result output (noise elimination, data deduplication, low-quality data filtering, multi-modal data fusion, multi-source decision fusion, etc.)This paper surveys data-fusion based ICMMSs, where we first introduced the motivation for fusing data in an ICMMS, including its advantages, applications, requirements, and challenges. Finally, this paper also summarized the future research directions and discussed about issues in the field of data fusion for data generation, acquisition, transmission, storage, analytics, and application.

In paper [4] Mishaal Mofleh Almutairi, Mohammad Yamin, G.D. Halikias, Adnan Abi Senexplains that Large crowds throughout a crisis may be tough to manage effectively and expeditiously, and need a coordinated strategy with the correct technology. the general public can not be curst for the inadequacy of resources, infrastructure, training, knowledge, and technology. a method to scale back congestion is to target one facet of it, however this approach isn't adequate on its own to unravel the matter. A additional comprehensive and property resolution is required. This paper offers an answer to the challenges that crowd management poses. The software system uses algorithms and validation ways to confirm accuracy. sadly, some teams of individuals will get out of management, turning into tough to regulate. Even methods and techniques cannot continually with success handle giant and unruly crowds.

In paper [5] A. M. Al-Shaery, M. O. Khozium, N. S. Farooqi, S. S. Alshehri and M. A. M. B. Al-Kawareviewed many heuristics-related articles possible to clear any fuzziness around the topic, gather the whole story behind its existence, present the latest advances and touch on its relation to crowd studies.Firstly, the paper browses the academic history of the topic and the methodologies under the same classification. Then, it directs the focus on the current role of heuristics in crowd studies. It distinguishes the difference between heuristics types.Finally, the paper previews the heuristic presence in crowd field problems and concludes that heuristics, in general, are helpful in various crowd management applications.

3. Data Collection

The data is collected from the references and official website of the Kumbh mela and hajj. The data taken here is the data of people who attended Kumbh mela and hajj.

4. Machine learning

The scientific discipline of machine learning enables computers to learn without explicit programming. One of the most intriguing technologies that has ever been developed is machine learning. The ability to learn is what, as the name suggests, gives the computer a more human-like quality. Today, machine learning is being actively used, possibly in a lot more places than one might think.

Any prospective data analyst or data scientist who wants to turn a vast amount of unstructured data into trends and predictions must have a solid understanding of machine learning. Learn this ability right now with the help of the Machine Learning Foundation - Self Paced Course, which was created and curated by specialists in the field with years of experience. Here we use Cross Validations.

For evaluating the effectiveness of machine learning models, cross validation is a highly helpful technique. Understanding how the machine learning model would generalise to a different collection of data is useful. Using this strategy, you want to gauge how accurate your model's predictions will be in real-world situations.

Two types of data sets—known data (training data set) and unknown data—will be provided to you when you are assigned a machine learning challenge (test data set). Using cross validation, you would be "testing" your machine learning model during the "training" phase to look for overfitting and to get a sense of how it would generalise to independent data, which is the test data set provided in the challenge.

You will have to separate your initial training data set into two portions for one cross validation round:

Set for cross-validation training
Validation set or cross validation testing set
You will use the cross-validation training set to train your machine learning model and the validation set to test its predictions. When you compare the model's predictions on the validation set and the actual labels of the data points in the validation set, you can determine how accurate your machine learning model's predictions are.

Multiple cross validation rounds are carried out utilising various cross validation training sets and cross validation testing sets in order to reduce the variation. To determine the machine's accuracy, the results from all the rounds are averaged.

5. Methodology

Method 1: K-Fold Cross Verification:

1. victimisation classic F-fold cross validation by ripping information into k-folds, k = 5;

2. Observations: All mixtures and averages of each the test and validation observations;

3. valid against: procedure complexness and validation accuracy;

4. Optimization: improving stability of the machine learning model across many knowledge inputs.

 This approach splits the given input dataset into K teams (K-fold) of sections of equal sizes. for each learning set, the K-fold prediction operate takes $(k - 1)$-folds, and therefore the remaining folds square measure reserved for the test set. victimisation this methodology, the output is discovered as less biased in comparison with alternative ways. This methodology takes a bunch because the standby or take a look at knowledge set, takes the remaining teams because the coaching dataset and tries to suit the model on the coaching set, and assesses the performance of the model victimisation the take a look at set for every cluster to enhance the steadiness of the model.
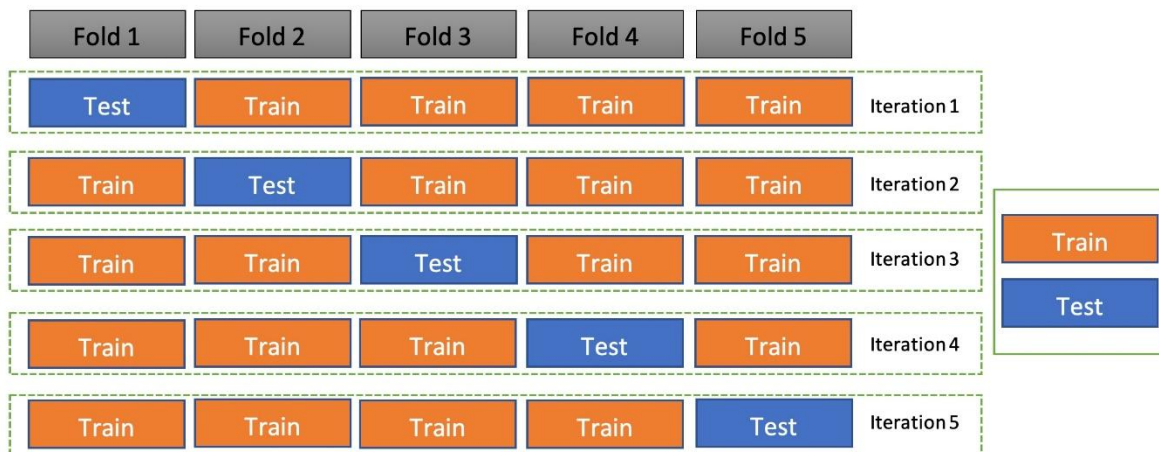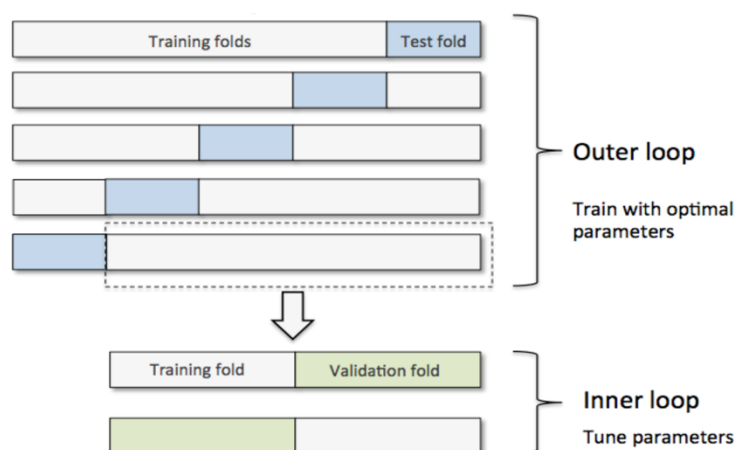

Method 2: Nested Cross Validation:

Method 2: Nested Cross Validation:

 • 1. victimisation nested cross validation strategy;

 • 2. Observations: Use inner loop (two-fold) for hyper parameter standardization, use outer loop (five-fold) for accuracy estimation;

• 3. valid against: Error estimation;

• 4. Optimization: improving hyper parameter standardization and estimating accuracy.

The nested cross-validation approach separates the hyper-parameter standardization step and therefore the error estimation step. This method uses the inner loop for hyper-parameter standardization and therefore the outer loop for estimating accuracy.

6. Results and Discussion

Both the methods have been applied and results are compared.

Table 1: Models comparision

Comparision		
	Precision	Accuracy
K-Cross validation	80%	77%
Nested cross Validation	82%	81%

7. Conclusion

From the analysis conducted in this paper, different artificial intelligence validations are applied on the data. Comparative study has been performed among the applied various techniques like K-cross validation, Net cross validation and Heuristic approach. After analysing their approaches for Crowd Management using social data. Net cross validation gives good result when compared to others. So Net cross validation model can be effectively utilized when used for crowd management in urban areas using data like social media data, crowd count etc.

REFERENCES

[1]. Bigdata Enabled Realtime Crowd Surveillance Using Artificial Intelligence and Deep Learning by Logesh Rajendran; R Shyam Shankaran (2021) (IEEE) DOI: 10.1109/BigComp51126.2021.00032

[2]. Crowd Management: A New Challenge for Urban Big Data Analytics by Clayson Celes, Azzedine Boukerche and Antonio L F Loureiro (2019) (IEEE) DOI:10.1109/MCOM.2019.1800640

[3]. Data Fusion for Intelligent Crowd Monitoring and Management Systems: A Survey XIANZHI LI 1,2, QIAO YU 2, BANDER ALZAHRANI 3, (Member, IEEE), AHMED BARNAWI 3, AHMED ALHINDI 4, (Senior Member, IEEE), DANIYAL ALGHAZZAWI3, (Senior Member, IEEE), AND YIMING MIAO 2, (Graduate Student Member, IEEE) (2021) DOI 10.1109/ACCESS.2021.3060631

[4]. A Framework for Crowd Management during COVID-19 with Artificial Intelligence (December 2021) (Sustainability 14(1):303) (DOI:10.3390/su14010303) by Mishaal Mofleh Almutairi, Mohammad Yamin, G.D. Halikias, Adnan Abi Sen

[5]. A. M. Al-Shaery, M. O. Khozium, N. S. Farooqi, S. S. Alshehri and M. A. M. B. Al-Kawa, "Problem Solving in Crowd Management Using Heuristic Approach," in *IEEE Access*, vol. 10, pp. 25422-25434, 2022, doi: 10.1109/ACCESS.2022.3156008.

[6]. Zhao, L., Wang, J., Liu, J., & Kato, N. (2019). Routing for Crowd Management in Smart Cities: A Deep Reinforcement Learning Perspective. IEEE Communications Magazine, 57(4), 88–93. doi:10.1109/mcom.2019.1800603

[7]. Felemban, E. A., Rehman, F. U., Biabani, S. A. A., Ahmad, A., Naseer, A., Majid, A. R. M. A., … Zanjir, F. (2020). *Digital Revolution for Hajj Crowd Management: A Technology Survey. IEEE Access, 8, 208583–208609.* doi:10.1109/access.2020.3037396.

[8]. Andrew J. Park; Ryan Ficocelli; Lee D. Patterson; Valerie Spicer; Frank Dodich; Herbert H. Tsang(2021).Modelling Crowd Dynamics and Crowd Management Strategies. doi:10.1109/IEMCON53756.2021.9623214.

[9]. Santana, J. R., Sanchez, L., Sotres, P., Lanza, J., Llorente, T., & Munoz, L. (2020). A Privacy-Aware Crowd Management System for Smart Cities and Smart Buildings. IEEE Access, 8, 135394–135405. doi:10.1109/access.2020.3010609.

[10]. Bai, Z., & Zhuo, R. (2020). Quality Management of Crowd Sensing Data Based on Machine Learning. 2020 Computer Information and Big Data Applications (CIBDA). doi:10.1109/cibda50819.2020.0004.