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Crowd Management System With Gene Expression Programming

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Abstract
The aim of this paper is a research classification between normal and abnormal crowd events using Gene Expression Programming algorithm. It is considered that the Crowd categories are divided into two: Normal Crowd or general crowds such as traffic jams, or public queues, and Abnormal Crowd or unusual crowds such as riots, brawls or there is one or some abnormal movement in a crowd. Currently, to detect crowds, they still use the general method by reporting to the authorities if there are crowds or abnormal events through surveillance cameras, this has the disadvantage of the large amount of time required in the reporting process which allows a large number of losses due to the abnormal crowd. Research on the development of Crowd Management System is needed to overcome these problems. This research begins with extracting the video from the surveillance camera, then do video processing. The result of video processing is set movement of various crowd classification criteria and is used as a set calculation formula using Gene Expression Programming algortihm, the algorithm can classification and learning some crowd criteria, like normal crowd, crowd density,traffic congestion, crowd flow and abnormal crowd. the Crowd criterion will have a different set in each category so that it can perform classification directly in one system, the system will recognize the criteria for each set and can be applied in public places that often occur Crowd.

Keywords: *Gene Expression Programming, Dynamic Optimization Problem, Crowd Management System, Abnormal Crowd, Classification Crowd*

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I. INTRODUCTION

Crowd is a number of activities a collection of objects or people who gather in one place [1]. Crowd can be categorized into several types, namely, Crowd dictation/counting to find out the number of people in a crowd area, Crowd management is divided into two parts, namely crowds that have abnormal behavior (abnormal) and people who have normal behavior in one crowd area. In the analysis of the Crowd area, it is also divided into Crowd density analysis (crowd density) to determine the density value in one crowd area, usually used to determine the density value if there is a disaster such as fire or earthquake in Crowd areas such as buildings and offices, and Crowd Flow to determine the direction of the movement of the crowd that occurs, is usually used for demonstration crowds [2]. Crowd Management System has been widely researched to overcome crowds in a place, including All Go Vision Video Analytics, this application is a desktop software which features Crowd Management System by analyzing video in real time with a focus on detecting crowd flow automatically [4], and iOmniscient and vedioIQ is a desktop software application that features a Crowd Management System by analyzing videos to analyze Crowd Counting, Crowding Detection, Overcrowding. Alert, Crowd Flow Analysis, Crowd Counter Flow Detection, with a smart system [5].

Previous research has proven that it can be used in detecting crowds, but there is still development by detecting normal and abnormal crowds, abnormal crowds are important for research, due to the need for early detection to detect noisy crowds, fast crowds, or anything that can cause crowds. hinder/remove control [1] . Data from the Central Statistics Agency records that every year the number of riots / brawls continues to increase, which has an impact on damage to public facilities, making it necessary to create an early riot detection system as an abnormal crowd, using CCTV facilities and developing information technology.

This study will propose a method of identifying and classifying Crowd Management System with the initial stages using assumptions as criteria for each Crowd, the existing assumptions include time linkage, continuous or discrete sets, predictable, visitable and optimize. This assumption will be an input in the form of a

chromosome gene expression algorithm. Crowd criteria used are Crowd Counting, Crowding Management, Crowd Density, Crowd Flow Analysis, and abnormal Crowd, each crowd criterion has a different set of behavior from the assumptions, so that the movement of the set behavior that occurs can detect the type of crowd that exists, with this concept crowd criteria will have a unique set of calculation values so that they can be made in one system. Gene Expression Programming acts as an optimization result of dynamic optimization problems [6], Gene Expression Programming algorithm has the advantage of being able to adapt quickly if the input changes in a fast time span [7], because the algorithm can evolve and adapt to a changing environment [8]..

1.1.1 Crowd Management System

Crowd is a number of activities of a collection of objects/communities gathered in one place Crowd in question is a commotion, a fast crowd, or anything that can inhibit/eliminate control [1], Crowd Management System is a system smart people who can categorize a crowd into one crowd criteria. Figure 1 shows the taxonomoy of the crowd.

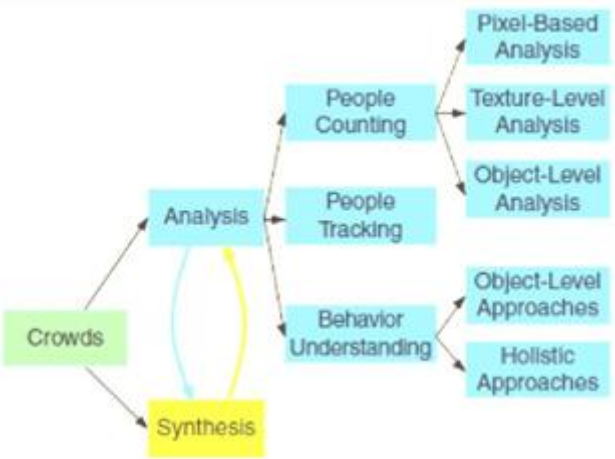

Figure 1 Taxonomy Crowd [2]

From the crowd taxonomy, it can be shown the development of existing applications in Figure 2.

Application Name/ Feature	AllGoVision	Iomniscient and vedioIQ	IPSOTEK	Qognify	VISIONGE NII
Desktop Application	✓	✓	✓	✓	✓
Crowd dictation /counting	✓	✓	✓	✓	✓
Crowd management	✓		✓	✓	✓
Overcrowding (People) alert	✓	✓	✓	✓	
Crowd density analysis		✓			
Traffic congestion		✓			
Crowd flow analysist	✓		✓		
Crowd counter flow dictation	✓			✓	

Figure 2 Crowd Management Commercial Application Features [2]

From figure 2, it is explained that the application that has been made with the crowd type feature, this research is a development of the previous application, with the aim of being able to meet all the crowd criteria.

1.1.2 Crowd Management System with Gene Expression Programming

The concept of a crowd management system with a genetic algorithm, begins with forming assumptions. The formation of assumptions is used to overcome problems that often occur in video processing, namely dynamic video, which has a change in analysis every time. assumptions made using the concept of dynamic optimization problems (DOP) [(Trung Thanh Nguyen, 2011)] were as follows

1. Time Linkage, this assumptions occurs in determining normal and abnormal crowds, because the input from this identification is video from surveillance cameras, surveillance cameras have video backgrounds that change every second, the intended background is the number of people, and the behavior of people, so this concept allows to overcome the problem of time.
2. Continuous/discrete: continuous/discrete is the concept of changing time to find out the background of the people and people behavior, with distributing continuous and discrete, people the background can be narrowed and categorized into crowd analysis results
3. Predictability: this concept detects the detected crowd whether it can be predicted, for example an abnormal crowd is identified there is a people movement that is different from the overall people, so the system can predict the people/crowd movement is still classified as normal or abnormal
4. visibility: on this assumption whether the crowd changes are visible in the optimization algorithm using genetic algorithms, or the algorithm needs to detect changes or can adapt itself to changes
5. Optimizing target: on this assumption it is necessary to optimize the percentage of results from crowd management identification to increase the sensitivity of the identification

The next step after determining the assumptions for crowd identification is to determine the type of crowd that exists. Table 1 shows the characteristics of crowd identification based on the nature of the crowd and assumptions

Table 1. Crowd Criteria

No	Criteria Crowd	Data Analysis	Data Type
1	Crowd dictation/ counting	How many people in one crowd area	Continues, with Time Linkage, Visibility and optimmizing
2	Crowd management	• How many people have abnormal behavior in the crowd	Discrete, with Time linkage, Predictability, visibility and optimizing
		• How many people have abnormal behavior in the crowd	Discrete, with Time Linkage, Visibility and optimmizing
3	Crowd density analysis	What is the density value in the crowd area	Continues, with Time linkage, Predictability, visibility and optimizing
4	Traffic congestion	What is the congestion level/delay value in one crowd area	Continues, with , visibility and optimizing
5	Crowd flow	Where is the movement of the crowd going (whether in one place/change)	Discrete, with Time Linkage and predictability

Table 1 shows the classification of crowd types that have behavior or analysis of different types of data, each crowd criterion has a different set of behavior, so that the movement of set behavior that occurs can detect the type of crowd that exists, with this concept the crowd criteria will have a calculated set value that unique so that it can be created in one system. The conditions for differentiating crowd types are as follows:

A. If it is called Discrete value, with the conditions of the camera as follows:
    a. "If in a population there is a small set that changes with the remaining small set remaining in a different time span, then the data is called combinatorial."
    b. Calculation of the small set can be seen the resulting behavior compared to the small residual set, if the comparison value exceeds the existing threshold value, it means that abnormal crowd management values can be detected, otherwise normal crowd management
    c. Calculation of the small set can be seen that there is a change in the resulting movement compared to the small residual set, if the resulting movement value exceeds the existing threshold value, it means that the crowd flow value is not detected and is not safe, otherwise it means that crowd flow is detected and safe.
B. Called continuous value, with the condition of the camera as follows:
    a. The data from the camera is extracted, and objects are labeled so that the crowd counting value is obtained
    b. Data from the camera is carried out in the process of calculating the outer area of the object minus the inside of the object, the corwd density value is obtained
    c. The data from the camera is carried out by the object transfer process to get the traffic congestion value

The next step to get optimization results from crowd detection problems using Gene Expression Programming algorithm, this algorithm is able to adapt to inputs that have fast time changes, this algorithm build a chromosome from a type of crowd, the chromosomes used are based on the assumption of the type of crowd. Chromosome based on crowd type shown in table 2

Table 2 . Chromosome based on crowd type

Chromosome Jenis Crowd						
Crowd Counting		**Y**	**K**	**N**	**Y**	**Y**
Crowd Management	**Normal**	**Y**	**D**	**N**	**Y**	**Y**
	Abnormal	**Y**	**D**	**Y**	**Y**	**Y**
Denstity Analisis		**Y**	**K**	**Y**	**Y**	**Y**
Traffic Congestion		**N**	**K**	**N**	**Y**	**Y**
Crowd Flow		**Y**	**D**	**N**	**Y**	**N**
Notes :	**Y**	**YES**				
	N	**NO**				

After being divided into different chromosomes, a variable called ADF (automatically define function) is created, as a sign of the recorded data classification results. the results of the ADF will carry out a genetic process.

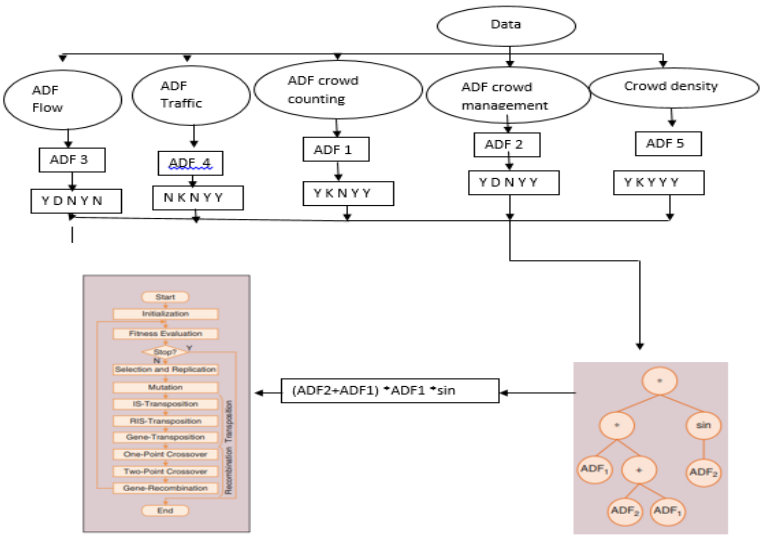

Figure 3. Chromosome ADF

it can be seen that each type of crowd has a different ADF and chromosome, the result of the chromosome is processed by gene expression programming, which will form a new gene. The new gene will be genetically processed as learning to recognize the environment/video that changes frequently. This allows the algorithm to continue running and detect when the input or video environment changes frequently

1.2 Implementation Crowd Management System

This section will explain how the crowd management system works using gene expression management, the system works using the Python programming language, to capture video objects, video extraction and video identification.

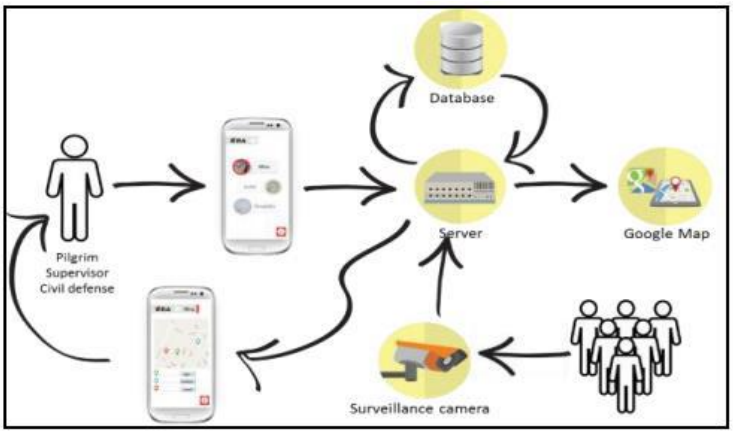

Figure 4. Impelentation Crowd Management System [2]

in Figure 4 shows the input through a surveillance camera, this camera functions to capture the crowd in the form of video connected by python. the extracted video is connected to the database to store data and the results of crowd identification, the results can also show the location of the incident from the video.
this implementation can be forwarded through the android application in the form of notifications if an abnormal crowd occurs, and can be enabled by security guards or security, so security does not need to monitor the number of surveillance cameras, officers are quite active when an abnormal crowd is detected
This research is limited to the context of testing the crowd management system in video format, and optimization with the gene expression programming algorithm

1.2.2 Hardware and Software Requirements

The following tools are needed to carry out this research.

Table 3: Hardware and Software Requirements.

No	Tools	Tools type	Desctiption
1	Personal Computer	Hardware	Minimum Ram 4GB
2	Python	Software	Python minimum version 3
3	pandas	Library	Python Library
4	tensorflow	Library	Python Library
5	keras	Library	Python Library
6	Sklearn	Library	Python Library
7	matplotlib	Library	Python Library

II. RESULT AND DISCUSSION

The results obtained are as discussed below

2.1 Crowd Management Result

The step of crowd management system test, it begins with testing the video format with the boston bomb incident sourced from youtube (https://www.youtube.com/watch?v=-9QzmEoDIYs). The selection of using this video is due to the large number of people activities that represent each type of crowd, the results are as follows.

Figure 5. Results of Crowd Management system

Figure 5 describes the results of the crowd management system with gene expression programming, through the Python programming language. the description of the results shown in Figure 6

```
Crowd_dictation_blue =

185


crowd_management_normal_green =

183


crowd_management_abnormal_blackwhite =

2  sign alert


crowd_density_blue =

12 people per square meter


traffic_purple =

0.8 = low level congestion


flow_red =

north
```

Figure 6. Crowd Management Results from python

crowd management system data results Figure 6 describe as follows

1. crowd dictation with blue color, the number of people detect around 185 people
2. Normal crowd management with green color, there are 183 people who have normal behavior
3. Abnormal crowd management in white and black color, counting 2 people, who have different behavior among other populations
4. Crowd density is marked in blue, this section functions to calculate the level of crowd, with an average of 12 people per square meter
5. traffic is marked in purple, to calculate the level of congestion, here is a value of 0.8 low-level congestion (below 1)
6. flow is marked in red, the dominant crowd is towards the north

The next test by making a real time video using a drone as a taker and recording video. the drone is connected to the server and database to perform the video processing and identify the detected type of crowd, the results shows in Figure 7

Figure 7. A Real Time Crowd Management Results

Figure 7 shows the results of crowds detected as abnormal crowds, because there are several groups of people who have different behaviors, such as falling down or lying down,

2.2 Gene Expression Programming Result

in this section shows the results of gene expression programming in the form of chromosomes that have been processed in 100 iterations, the first step in testing this algorithm is to connect a drone camera with python software, the shows in Figure 8

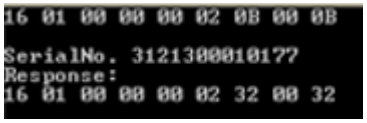

Figure 8. Connected Drone Camera series into python

the results show the connection between the camera drones that are connected via the server and the database, the serial number that appears shows the system has been connected, the complete results of the gene expression programming shows in figure 9 and table 4

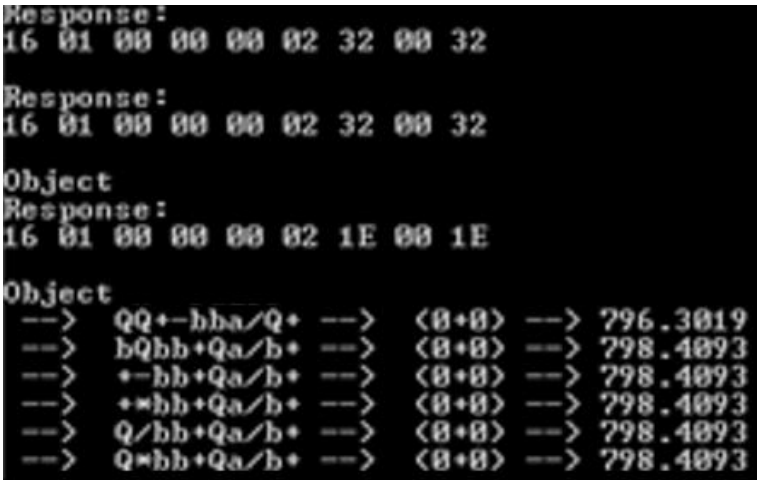

Figure 9. Result of Gene Expression Programming

Table 4. Result of Gene Expression Programming

Crowd Type	Cromosome					Optimization Chromosome	Accurate (%)
Crowd Counting	Y	K	N	Y	Y	QQ+-bba/Q+	79.6

Crowd Mangement Normal	Y	D	N	Y	Y	bQbb+Qa/b+	79.8
Crowd Management abnormal	Y	D	Y	Y	Y	+-bb+Qa/b+	79.8
Crowd Density	Y	K	Y	Y	Y	+*bb+Qa/b+	79.8
Traffic Congestion	N	K	N	Y	Y	Q/bb+Qa/b+	79.8
Crowd Flow	Y	D	N	Y	N	Q*bb+Qa/b+	79.8

The results show the optimization chromosom for each type of crowd, the optimization of the crowd using the function rules F = {Q,*,/,-,+} and the terminal rule T= {a,b}, and the crowd type chromosome [9], the results of all crowd types get accuracy values average 79%

III. CONCLUSION

In general the purpose of this research has been to develop a classification of Crowd Management System. This classification can differentiate between normal and abnormal crowd events. This research can be an accurate various Crowd classification technique, with accurate results reaching 79.8%, so that it can quickly find out if there is an abnormal crowd.

This research is an innovation in making decisions using algorithms based on assumptions, this algorithm can be done if they can represent the existing criteria. Crowd Management System with Gene expression programming is one of the assumptions algrotihm that can be run and developed into an android application or web-based application.

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