EXTENDED ABSTRACT - RESEARCH PROJECT
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Applying and Testing the Accuracy of a Machine Learning Based Human Identification System for Home Security

Hansen Yosia Geraldi 1*, Alexander Maximilliano 2*
hansen.yg@santa-laurensia.sch.id, alexander.m@santa-laurensia.sch.id, nicolaus.adityoso@santa-laurensia.sch.id

Introduction

Human identification systems have been on the rise for the last 5 years. Though home security technology has not adopted this system on a large scale. This is due to the fact that most home security systems use motion sensors. This may lead to inaccurate identification of intruders with other creatures such as other warm blooded animals. Therefore by integrating human identification system algorithms this error in identification can be minimized. The algorithm this system will use is based on a machine learning model called HOG (histogram of oriented gradient).

There are many methods to object detection through a camera, but all of them fundamentally involve machine vision. Machine vision is where the experience of what human vision would be like is simulated for the computer system (Manakitsa, 2024). This is usually done through using a camera. From this, the algorithms in the system will have the necessary data to identify objects or people.

Keywords: machine learning, home security, human detection, alarm system, HOG.

Research Methodology

In order to create the system itself, installing opencv on any coding software such as visual studio code will be necessary. Installing numpy and cv2 using command prompt from the computer will also be necessary. Python will be used as the coding language.

For the program, first create a line of code for turning on the camera. Then adding the human detection algorithm through opencv. Then, assigning the amount of objects detected by the amount of green squares as a variable. After this, add a condition if that variable is one or more for more than 2 seconds, then an audio sound will be activated.

This research tests the accuracy of the system's identification by putting the system under three scenarios. The scenarios are when only a human is in the camera's point of view, when only an animal is in the camera's point of view, and when both a human and animal is in the camera's point of view. The data obtained on detection and whether or not the alarm sounds from the test is then compared to the theoretical outcome for those scenarios. The theoretical outcome is obtained through using mathematical logical operators and a truth table.

Truth Table (for complete one reference full report)

Truth table for one type (only humans or animals alone):

A	D	H	S	¬A	¬H	¬D	¬S	H↔D	A nor D	(H↔D)∧S	(A nor D) and not S
F	T	T	T	T	F	F	F	T	F	T	F
T	F	F	F	F	T	T	T	T	F	F	F

Truth table for two types (human and animal):

H	A	D	S	¬A	(H∧¬A)	(H∧A)	(H∧¬A)∨(H∧A)	(D∧S)	((H∧¬A)∨(H∧A))∧(D∧S)
T	T	T	T	F	F	T	T	T	T

Result and Analysis

Trial 1:

No	Type of creature	No of people (actual)	No of animal (actual)	Detected (yes or no)	Alarm on/off
1	Human	1	0	yes	on
2	Human and Dog	1	1	yes	on
3	Dog	0	1	no	off

Trial 2:

No	Type of creature	No of people	No of animal	Detected (yes or	Alarm on/off

		(actual)	(actual)	no)	
1	Human	1	0	yes	on
2	Human and Dog	1	1	yes	on
3	Dog	0	1	no	off

Trial 3:

No	Type of creature	No of people (actual)	No of animal (actual)	Detected (yes or no)	Alarm on/off
1	Human	2	0	yes	on
2	Human and Dog	1	1	yes	on
3	Dog	0	1	no	off

By comparing the results from testing the system and the truth table, it can be observed that both have the same outcome. This is when a human is present, he/she will be detected and the alarm will sound. However, when an animal is present, then it won't be detected and therefore an alarm won't sound. If there are both subjects present, then only the human will be detected and the alarm will sound. Therefore, the system can be considered 100% accurate.

Although, there is a downside in terms of consistency of identification. Consistency means how much out of the total time will the object be detected. In this case, the system only identified the human for only a short period of time relative to the total time.

A solution to this could be to apply deep learning instead of machine learning. This is because deep learning has automated feature extraction as compared to a manual one in machine learning (Sarker, 2021). Therefore, the performance including consistency of detection would improve drastically more when given more data if deep learning was used unlike machine learning in which the performance increase stagnates after a certain amount of data is used.

Conclusion

This research is successful in applying a human detection system for a home alarm system by connecting it to an audio alarm. The results yielded from the tests of this system also shows that the system is completely accurate based on the comparison for those scenarios on the truth table. Therefore, systems such as this may have potential as a primary indicator for home security alarms.

A suggestion for future iterations of similar systems based on this research would be using deep learning instead of machine learning. This would improve the consistency in systems which do human identification.

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