Intelligent Video Moving Target Detection Based on Multi-Attribute Single Value Medium Neutrosophic Method

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Abstract

Competition in social sports has many benefits for athlete training due to this competition gives researchers a chance to making and developing new methods and ways that support them. The competition in sport growth rapidly these days. During the last several years, there has been a significant increase in the volume of traffic using multimedia. In addition, some of the most recent paradigm shifts suggested, such as IoT, bring about the introduction of new kinds of traffic and applications. Software-defined networks, often known as SDNs, are beneficial to network management since they enhance its capabilities. When used with SDN, artificial intelligence (AI) has the potential to solve network issues using categorization and estimate strategies. So, in this paper discuss and develop a new method for sports video moving target detection. This method is based on multi-criteria decision making (MCDM) because targeting detection has many criteria and sub-criteria. This paper collected five main criteria and twenty sub-criteria impacts in target detection of sports video. We use the Analytical hierarchy Process (AHP) to determine the importance of these criteria and their weights. These criteria were evaluated under a neutrosophic environment. An application is provided to measure the outcome of the proposed method.

Keywords: AHP; Intelligent Video Moving; Target Detection; Neutrosophic Set

1. Introduction

In recent years, athlete training was weak and stiff, but these days is becoming quickly and powerful due to increased completion in sports. Also, athlete training depends on the coach's opinions only, but this development can depend on record and video target detection[1]–[4]. Many technologies are applied in sports video for more accuracy and performance, like computer vision[5]–[7].

DOI: https://doi.org/10.54216/JISIoT.050105
Received: March 18, 2021 Accepted: June 18, 2021

In this paper, we introduce five main criteria and twenty sub-criteria for assessment and help the athlete. These criteria are enormous and conflict criteria. So, we use the multi-criteria decision making (MCDM) concept for dealing with these criteria[8]. We use the MCDM method in this paper, like the AHP method. AHP method is an easy method and can provide weights of criteria and sub-criteria[8]–[13].

During the last several years, there has been a significant increase in the transmission of video across networks. According to several assessments, this pattern is expected to continue its upward trajectory over the next several years. As compared to the amount of video traffic in 2016, the amount of video traffic in 2021 will be three times more. In addition to that, by 2021, this traffic will account for 82% of the overall traffic on the Internet. In addition to that, it predicts that the traffic on the Internet caused by video surveillance will be seven times higher over that same period compared to the traffic that we already have. In addition, Cisco forecasts that in the year 2021, video surveillance traffic will account for 3.4% of all the video traffic that will be carried over the Internet.

The AHP method is integrated with neutrosophic sets for dealing with incomplete and uncertain information. We use the Single-Valued Neutrosophic Sets scale, which includes three values: Truth, indeterminacy, and falsity[14]–[17]. The neutrosophic sets dealing with the problem of decision making. The neutrosophic sets are better than the fuzzy systems. Due to fuzzy systems containing only two values, truth and falsity values, they do not consider the indeterminacy value in their calculations. This paper's main contribution is the first-time introducing sports video moving target detection under neutrosophic and integrated AHP method.

The rest of this paper is organized as. The following: Section two discusses the related wok. Of the main research topic. Then section three provides a detailed description about the used methodology, section four explains an application as a case study of the proposed method. Finally, section five concludes the paper.

2. Related work

In a surveillance IoT environment that is linked by an SDN, Rego et al. [18] suggested an artificial intelligence system that is capable of identifying and correcting faults in the transmission of multimedia content. The architecture, methodology, and communications of the SDN are described. The architecture of the AI system is broken out here, as well as the test environment and the data collection. Iakovidis and colleagues[19] had proposed a unique approach to facilitate the diagnosis of adenomas in gastrointestinal video endoscopy. This system was developed by the researchers. It is distinct from other systems in that it can process input video of a standard, lower resolution. This results in a reduced need for processing resources, which in turn makes portability and the possibility of telemedicine applications easier to achieve. It does this by combining the sophisticated processing methods of support vector machines (SVMs) and color–texture analysis approaches into a framework for effective pattern identification. An intelligent approach for the identification of gastrointestinal polyps in endoscopic video has been presented by Mostafiz et al.[20] .The use of video endoscopy as a diagnostic tool for evaluating gastrointestinal polyps is becoming more common. Nevertheless, the accuracy of the diagnosis is largely dependent on the expertise of the physicians, which is necessary in many situations to discover polyps. There is hope that computer-assisted polyp identification may lower the percentage of times that polyps go undetected and, therefore, enhance the precision of diagnostic outcomes.

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Chen et al. [21]suggested an elaborate collaboration strategy supply energy-efficient QoE-aware wireless video communications by properly utilizing the short transmission resources of cellular connections for 5G. The goal of this approach was to provide wireless video communications without negatively impacting user experience. They began by doing research on the emotion-aware intelligent system quality of experience assessment, which was based on objective criteria of service quality (QoS). After that, they made advantage of the multi-layered collaborations of the physical, network, and application levels amongst the linked users to create energy-efficient and quality-of-experience-aware video communications.

By developing a complete multi modal system, Prathish et al. [22]established a strategy that allows one to take an exam without the direct supervision of a proctor at any point throughout the test. To record audio and video, as well as active window capture, we made use of specialized gear such as webcams. Mabrouk et al. [23]are interested in the research of the two key processes that compose a video surveillance system, which are known as the behavior modelling and the behavior representation, respectively. they look at several approaches to behavior representation that include the extraction and description of features. Also given are frameworks for behavior modelling as well as classification approaches. Olatunji and Cheng [24]gave a presentation on recent developments in the field of video analytics studies as well as emerging trends from a variety of subdomains, including behavior analysis, moving object classification, video concise overview, object tracking, object tracking, congestion analysis, abnormality detection, and information fusion from surveillance devices. In addition to that, they provided an overview of current advancements in video analytics and intelligent video systems (IVS). It is well recognized that the linguistic information conveyed in the spoken sections of a video may transmit important features about the context and emotions being shown. In order to get such an understanding from the video transcriptions of a large-scale multimodal dataset, Stappen et al. [25]investigated the viability of a lexical knowledge-based extraction strategy (MuSe-CAR). Ibrahim [26]intended to give a general overview of intelligent surveillance systems and discuss some possible sensor modalities and the scenarios in which they could be fused together. These sensor modalities included visible camera (CCTV) systems, infrared camera systems, thermal camera systems, and radar systems. Cherkasov et al. [27]committed themselves to reflecting on many different facets of the formation of an intellectual system that recognizes gestures. The intellectual block of the system is totally built on open technologies, namely the OpenCV library and the Microsoft Cognitive Toolkit platform. This is the distinguishing feature of the system. They described the reasons for choosing such a collection of tools, as well as the functional plan of the system and the hierarchy of its modules. In addition, they discussed the implications of the decision. Table 1 shows the comparison between previous studies.

Table 1: The comparison between previous studies in intelligent systems for video movement.

Study	Advantage	Disadvantage
Rego et al. [18]	In the context of Internet of Things environments, Rego et al. presented an Intelligent System for Video Surveillance.	Bad system accuracy
Iakovidis et al. [19]	Provided an innovative method for assisting in the diagnosis of adenomas via the use of gastrointestinal video endoscopy.	Not improved accuracy

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Mostafiz et al.[20]	Intelligent approach for the identification of gastrointestinal polyps in endoscopic video	Because of the limitations imposed by both the technology and the length of time, there is only a very minimal chance of obtaining false positive or false negative results.
Chen et al.[21]	Chen et al. suggested an elaborate collaboration strategy supply energy-efficient QoE-aware wireless video communications by properly utilizing the short transmission resources of cellular connections for 5G.	They took into account just one possible scenario for the cell.
Prathish et al.[22]	Established a strategy that allows one to take an exam without the direct supervision of a proctor at any point throughout the test.	Tested on e-learning only
Mabrouk et al.[23]	Interested in the research of the two key processes that compose a video surveillance system, which are known as the behaviour modelling and the behaviour representation, respectively	Small size of dataset
Olatunji and Cheng[24]	Olatunji and Cheng gave a presentation on recent developments in the field of video analytics studies	Not concentrating on any of the components that come together to form an automated video surveillance and monitoring system.
Stappen et al.[25]	Investigated the viability of a lexical knowledge-based extraction strategy	Not used unsupervised learning
Ibrahim[26]	Give a general overview of intelligent surveillance systems and discuss some possible sensor modalities and the scenarios in which they could be fused together.	Bad system accuracy
Cherkasov et al.[27]	Reflecting on many different facets of the formation of an intellectual system that recognises gestures	Bad quality of recognition

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3. The Methodology

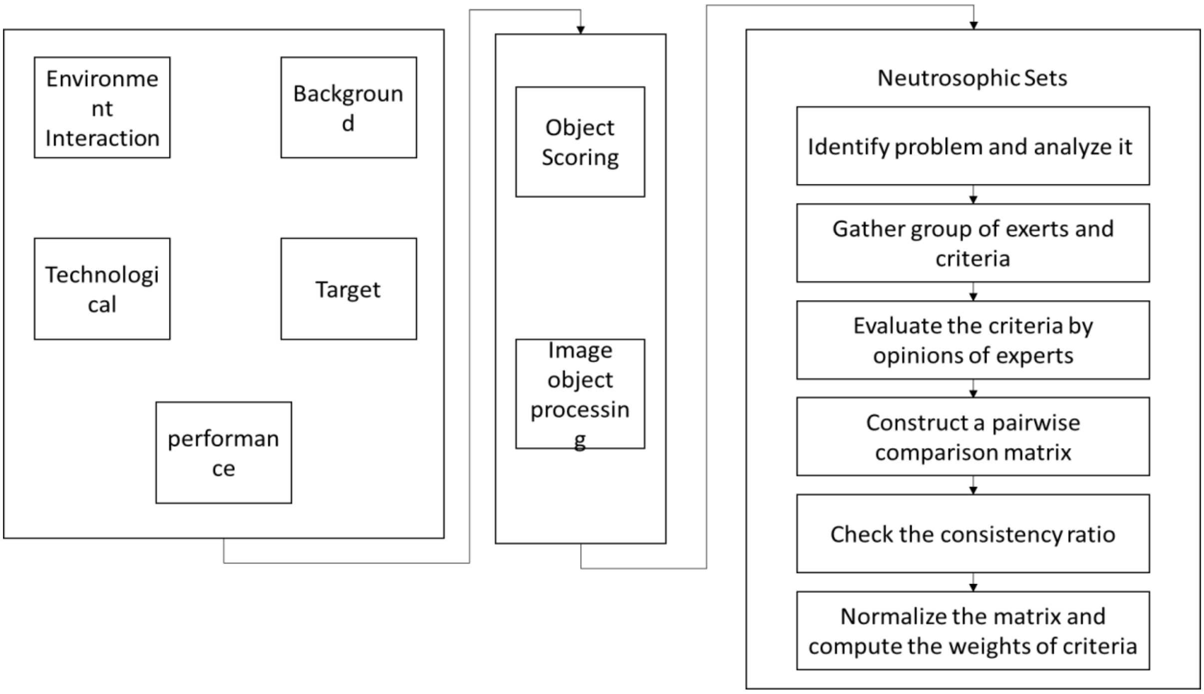

Fig 1: The proposed methodology

It is necessary for the proposed intelligent algorithm to annotate bounding boxes and confidence ratings on objects of each class for every frame that is shown in a movie. While there have been algorithms developed for recognizing things in movies, most of these approaches concentrate on identifying a certain category of items, such as pedestrians. Neutrosophic sets are a generalization of classical fuzzy sets, intuitionistic fuzzy sets, and fuzzy sets, and they represent the uncertainty, inconsistency, and incompleteness of knowledge on real-world issues. They do a good job of representing difficulties that occur in the actual world by considering the truthiness, indeterminacy, and falsity of the contexts in which decisions are made. Consequently, integrating these sets with AHP is superior to fuzzy AHP and intuitionistic fuzzy AHP in terms of handling vagueness and uncertainty. This is since it considers three distinct grades: membership degree, indeterminacy degree, and non-membership degree. Figure 1 demonstrates how the neutrosophic AHP may be used to address deficiencies in priority calculations.

The conceptualization of the issue in a hierarchical fashion. It indicates that the issue has been addressed via the use of objectives, alternates, criteria, and sub-criteria. The building of a pairwise comparison matrix, or, to put it another way, the neutrosophic choice matrix. Neutrosophic numbers are a defining characteristic of the haziness of those who make decisions. The calculation of the relative importance of each criteria using the appropriate neutrosophic decision matrix.

In this section we use the AHP method under neutrosophic sets to sports video moving target detection. We use a Single Valued Neutrosophic Sets (SVNSs) for evaluate the criteria and sub criteria by using a Single valued Neutrosophic Numbers (SVNNs). Which consist of three values truth, indeterminacy and falsity value. We use a scale of neutrosophic as [28]. The following steps of the AHP method.

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Step 1: Identify problem and analyze it

Step 2: Gather group of exerts and criteria

Step 3: Evaluate the criteria by opinions of experts

Step 4: Construct a pairwise comparison matrix

$$X = \begin{bmatrix} 1 & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & 1 \end{bmatrix}$$

Step 5: Combine the matrix from previous step into one matrix

Step 6: Check the consistency ratio

$$CR = \frac{CI}{RI}$$

$$CI = \frac{lambda\_\max - n}{n-1}$$

Step 7: Normalize the combined matrix

$$No = \frac{x_i}{\sum_{i=1}^{n} x_i}$$

Step 8: Compute the weights of criteria by mean value of each row.

$$W_i = \frac{no_i}{\sum_{i=1}^{n} no_i}$$

Algorithm 1: Pseudo code of N-AHP

INPUT:	**N: NUMBER OF CRITERIA**
	O: NUMBER OF PAIRWISE COMPARISON MATRIX
OUTPUT:	W: weights of criteria
FOR	O:1 to k do
	1: Build the pairwise comparison matrix
	2: Combined the pairwise comparison matrix
	3: Check the CR
	If CR>0.1 then
	Return to 1.
	Else:
	Go to 4.
	End
	4. Normalize the pairwise comparison matrix
	5. Compute the weights of criteria
END	
END	

4. Applications and Results

This section proposed the output of the proposed methodology under a neutrosophic environment. We use the scale of neutrosophic and numbers as in. We use a Single valued neutrosophic number which contains three

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values, Truth, Indeterminacy, and falsity values. First, we select three experts to assess the five main and twenty sub-criteria. Criteria are C1:Environemnt Interaction, C1.1: Atmospheric effects, C1.2:Reliability, C1.3: hardware integration. C2: Background, C2.1:Background color, C2.2: background region, C2.3: noise, C3: Technological, C3.1: Technical part, C3.2: Flexibility, C3.3: programming, C3.4: computational power, C3.5: speed, C4: Target, C4.1: Type of target, C4.2: Target size, C4.3: ability to detect the desired target, C4.4: target maintainability, C4.5: target availability, C5: performance, C5.1: Motion target, C5.2: time-dependent, C5.3 accuracy, C5.4: security. Build the pairwise comparison matrix by opinions of experts in Table 2-4. Then Combined them in Table 5. Then normalize the matrix in Table 6. Then compute the weights of criteria in Table 7. Fig 2. Present the weights of the main criteria.

Table 2: Pairwise comparison matrix for five main criteria by first decision makers.

	C_1	C_2	C_3	C_4	C_5
C_1	0.5	0.283	0.8167	0.9	0.8167
C_2	3.533569	0.5	0.283	0.383	0.9
C_3	1.22444	3.533569	0.5	0.283	0.283
C_4	1.111111	2.610966	3.533569	0.5	0.383
C_5	1.22444	1.111111	3.533569	2.610966	0.5

Table 3: Pairwise comparison matrix for five main criteria by second decision makers.

	C_1	C_2	C_3	C_4	C_5
C_1	0.5	0.9	0.283	0.8167	0.383
C_2	1.111111	0.5	0.8167	0.383	0.8167
C_3	3.533569	1.22444	0.5	0.383	0.283
C_4	1.22444	2.610966	2.610966	0.5	0.283
C_5	2.610966	1.22444	3.533569	3.533569	0.5

Table 4: Pairwise comparison matrix for five main criteria by third decision makers.

	C_1	C_2	C_3	C_4	C_5
C_1	0.5	0.8167	0.3833	0.2833	0.9
C_2	1.22444	0.5	0.8167	0.9	0.8167
C_3	2.608923	1.22444	0.5	0.8167	0.9
C_4	3.529827	1.111111	1.22444	0.5	0.383
C_5	1.111111	1.22444	1.111111	2.610966	0.5

Table 5. Combined matrix for five main criteria.

	C_1	C_2	C_3	C_4	C_5
C_1	0.5	0.666567	0.494333	0.666667	0.6999
C_2	1.956373	0.5	0.6388	0.555333	0.844467
C_3	2.455644	1.99415	0.5	0.494233	0.488667
C_4	1.955126	2.111014	2.456325	0.5	0.349667
C_5	1.648839	1.186664	2.726083	2.9185	0.5

DOI: https://doi.org/10.54216/JISIoT.050105
Received: March 18, 2021 Accepted: June 18, 2021

Table 6: Normalized combined matrix for five main criteria.

	C_1	C_2	C_3	C_4	C_5
C_1	0.058713	0.103209	0.07253	0.129835	0.242793
C_2	0.22973	0.077419	0.093727	0.108152	0.292943
C_3	0.288357	0.308769	0.073362	0.096253	0.169517
C_4	0.229583	0.326864	0.360401	0.097376	0.121298
C_5	0.193617	0.18374	0.39998	0.568384	0.173449

Table 7: Weights of criteria.

	Weights of criteria
C_1	0.121416
C_2	0.160394
C_3	0.187251
C_4	0.227104
C_5	0.303834

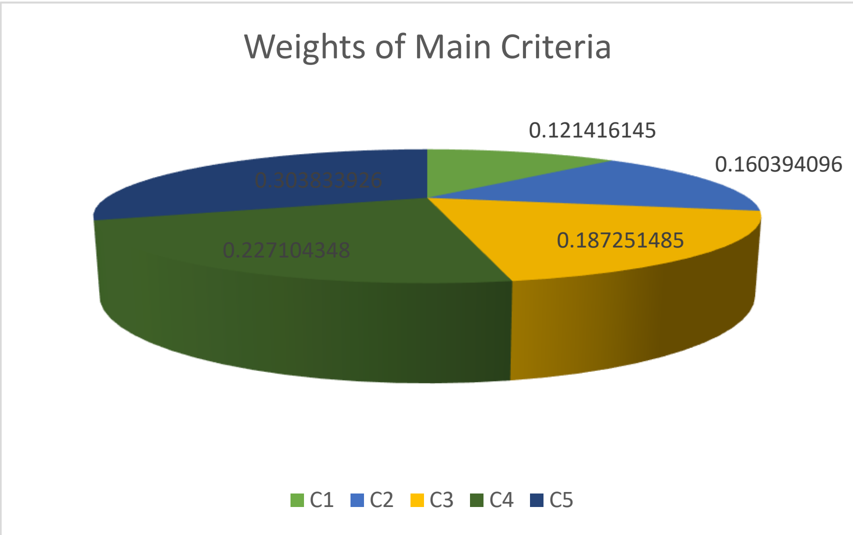

Figure 2: Weights of main criteria.

Then compute the weights of sub-criteria. Start with C1: C1.3 is the highest weight and impotence, and C1.1 is the lowest weight and importance. In C2: C2.3 is the highest weight and impotence, and C2.1 is the lowest weight and importance. C3.5 is the highest weight and impotence, and C3.1 is the lowest weight and importance. C4.5 is the highest weight and impotence, and C4.1 is the lowest weight and importance. C5.4 is the highest weight and impotence, and C1.1 is the lowest weight and importance.

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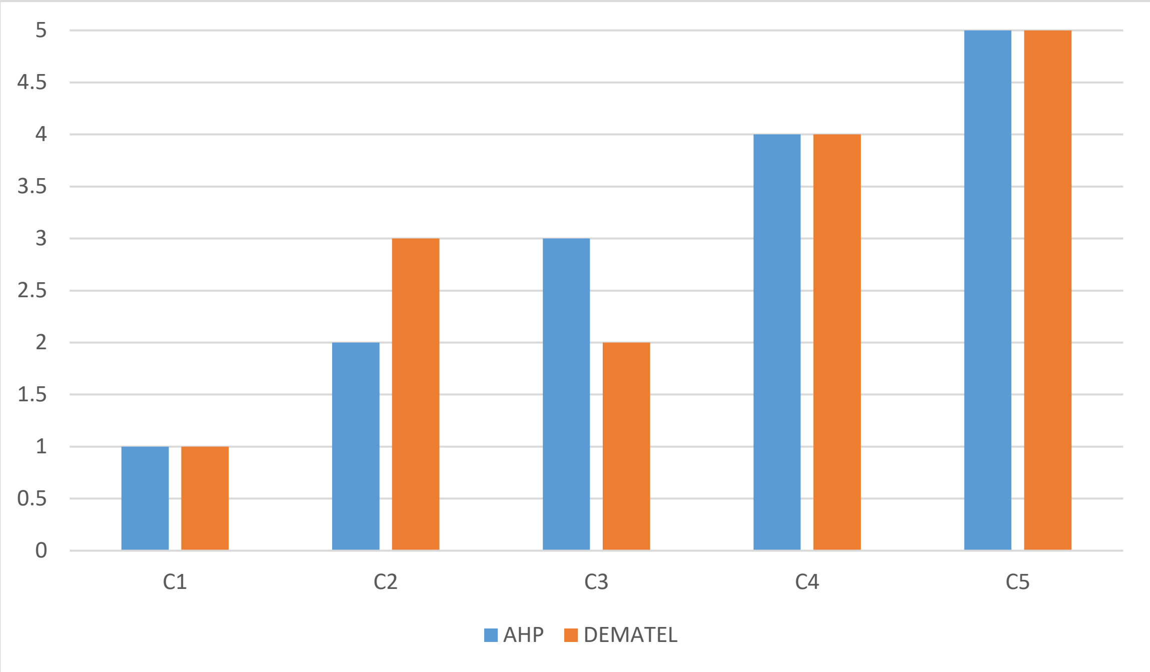

Figure 3: The comparison between the Neutrosophic AHP and Neutrosophic DEMATEL method.

We compare between the neutrosophic AHP and neutrosophic DEMATEL methods to validate the proposed methodology. The rank made by the AHP and DEMATEL methods. The criterion 5 is the highest rank in both AHP and DEMATEL method. The criterion 1 is the lowest rank in both AHP and DEMATEL methods.

5. Conclusions

In this paper, we introduce the AHP method under a neutrosophic environment by using SVNSs. Three experts were selected to assess the main and sub-criteria. in this paper, and we use five main criteria and twenty sub-criteria. The first time for sports video detection under neutrosophic value.

References

[1] J. Dai-Hong, D. Lei, L. Dan, and Z. San-You, "Moving-object tracking algorithm based on PCA-SIFT and optimization for underground coal mines," *IEEE Access*, vol. 7, pp. 35556–35563, 2019.

[2] X. Yuan, J. Liu, and X. Hao, "A moving block sequence-based evolutionary algorithm for resource investment project scheduling problems," *Big Data & Information Analytics*, vol. 2, no. 1, p. 39, 2017.

[3] X. Hao, J. Liu, X. Yuan, X. Tang, and Z. Li, "A moving block sequence-based evolutionary algorithm for resource-constrained project scheduling problems," *International Journal of Bio-Inspired Computation*, vol. 14, no. 2, pp. 85–102, 2019.

[4] T. Yao, Y. Luo, Y. Chen, D. Yang, and L. Zhao, "Single-image super-resolution: A survey," in *International Conference in Communications, Signal Processing, and Systems*, 2018, pp. 119–125.

[5] H. Yu, A. Sharma, and P. Sharma, "Adaptive strategy for sports video moving target detection and tracking technology based on mean shift algorithm," *International Journal of System Assurance Engineering and Management*, pp. 1–11, 2021.

DOI: https://doi.org/10.54216/JISIoT.050105
Received: March 18, 2021 Accepted: June 18, 2021

[6] S. Hossain and D. Lee, "Deep learning-based real-time multiple-object detection and tracking from aerial imagery via a flying robot with GPU-based embedded devices," *Sensors*, vol. 19, no. 15, p. 3371, 2019.

[7] X. Huang, T. Zhang, Z. Deng, and Z. Li, "Design of moving target detection and tracking system based on cortex-A7 and openCV.," *Traitement du Signal*, vol. 35, no. 1, 2018.

[8] D. Ajay, J. Aldring, S. Abirami, and D. Jeni Seles Martina, "A SVTrN-number approach of multi-objective optimisation on the basis of simple ratio analysis based on MCDM method," *International Journal of Neutrosophic Science*, vol. 5, no. 1, pp. 16–28, 2020.

[9] M. Mathew, R. K. Chakrabortty, and M. J. Ryan, "A novel approach integrating AHP and TOPSIS under spherical fuzzy sets for advanced manufacturing system selection," *Engineering Applications of Artificial Intelligence*, vol. 96, p. 103988, 2020.

[10] A. Darko, A. P. C. Chan, E. E. Ameyaw, E. K. Owusu, E. Pärn, and D. J. Edwards, "Review of application of analytic hierarchy process (AHP) in construction," *International journal of construction management*, vol. 19, no. 5, pp. 436–452, 2019.

[11] K. D. Goepel, "Implementation of an online software tool for the analytic hierarchy process (AHP-OS)," *International Journal of the Analytic Hierarchy Process*, vol. 10, no. 3, 2018.

[12] H.-M. Lyu, W.-H. Zhou, S.-L. Shen, and A.-N. Zhou, "Inundation risk assessment of metro system using AHP and TFN-AHP in Shenzhen," *Sustainable Cities and Society*, vol. 56, p. 102103, 2020.

[13] Y. Liu, C. M. Eckert, and C. Earl, "A review of fuzzy AHP methods for decision-making with subjective judgements," *Expert Systems with Applications*, p. 113738, 2020.

[14] S. Zhao, D. Wang, C. Liang, Y. Leng, and J. Xu, "Some single-valued neutrosophic power heronian aggregation operators and their application to multiple-attribute group decision-making," *Symmetry*, vol. 11, no. 5, p. 653, 2019.

[15] G. Wei and Y. Wei, "Some single-valued neutrosophic dombi prioritized weighted aggregation operators in multiple attribute decision making," *Journal of Intelligent & Fuzzy Systems*, vol. 35, no. 2, pp. 2001–2013, 2018.

[16] M. Şahin, V. Ulucay, and H. Acıoğlu, "Some weighted geometric averaging operators and weighted arithmetic operators on SVNSs."

[17] M. Şahin, V. Uluçay, and H. Acıoglu, *Some weighted arithmetic operators and geometric operators with SVNSs and their application to multi-criteria decision making problems*. Infinite Study, 2018.

[18] A. Rego, A. Canovas, J. M. Jiménez, and J. Lloret, "An intelligent system for video surveillance in IoT environments," *IEEE Access*, vol. 6, pp. 31580–31598, 2018.

[19] D. K. Iakovidis, D. E. Maroulis, and S. A. Karkanis, "An intelligent system for automatic detection of gastrointestinal adenomas in video endoscopy," *Computers in biology and medicine*, vol. 36, no. 10, pp. 1084–1103, 2006.

[20] R. Mostafiz, M. Hasan, I. Hossain, and M. M. Rahman, "An intelligent system for gastrointestinal polyp detection in endoscopic video using fusion of bidimensional empirical mode decomposition and convolutional neural network features," *International Journal of Imaging Systems and Technology*, vol. 30, no. 1, pp. 224–233, 2020.

[21] X. Chen, Y. Zhao, and Y. Li, "QoE-Aware wireless video communications for emotion-aware intelligent systems: A multi-layered collaboration approach," *Information Fusion*, vol. 47, pp. 1–9,

DOI: https://doi.org/10.54216/JISIoT.050105
Received: March 18, 2021 Accepted: June 18, 2021

2019.

[22] S. Prathish and K. Bijlani, “An intelligent system for online exam monitoring,” in *2016 International Conference on Information Science (ICIS)*, 2016, pp. 138–143.

[23] A. Ben Mabrouk and E. Zagrouba, “Abnormal behavior recognition for intelligent video surveillance systems: A review,” *Expert Systems with Applications*, vol. 91, pp. 480–491, 2018.

[24] I. E. Olatunji and C.-H. Cheng, “Video analytics for visual surveillance and applications: An overview and survey,” *Machine Learning Paradigms: Applications of Learning and Analytics in Intelligent Systems*, pp. 475–515, 2019.

[25] L. Stappen, A. Baird, E. Cambria, and B. W. Schuller, “Sentiment analysis and topic recognition in video transcriptions,” *IEEE Intelligent Systems*, vol. 36, no. 2, pp. 88–95, 2021.

[26] S. W. Ibrahim, “A comprehensive review on intelligent surveillance systems,” *Communications in science and technology*, vol. 1, no. 1, 2016.

[27] K. V Cherkasov, I. V Gavrilova, E. V Chernova, and A. S. Dokolin, “The use of open and machine vision technologies for development of gesture recognition intelligent systems,” in *Journal of Physics: Conference Series*, 2018, vol. 1015, no. 3, p. 32166.

[28] M. Abdel-Basset, A. Gamal, N. Moustafa, A. Abdel-Monem, and N. El-Saber, “A Security-by-Design Decision-Making Model for Risk Management in Autonomous Vehicles,” *IEEE Access*, 2021.

DOI: https://doi.org/10.54216/JISIoT.050105
Received: March 18, 2021 Accepted: June 18, 2021