



Neutrosophic MCDM Model for Assessment Factors of Wearable Technological Devices to Reduce Risks and Increase Safety: Case Study in Education

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Abstract

This study investigates the feasibility of using wearable technologies in education to improve safety. This article explores how wearables may be used to improve school safety and wellness, as well as their advantages, disadvantages, and future potential. The article covers a wide range of wearable gadgets and their respective safety-related features, from smartwatches to location trackers to panic buttons and biometric sensors. Privacy issues, data security, user acceptability, and ethical considerations are only some of the problems and hazards discussed in this research on wearables in education. This study the neutrosophic set to deal with uncertain data. The neutrosophic set is integrated with the multi-criteria decision-making (MCDM) CRITIC method. The CRITIC method is used to compute the weights of factors and rank it. There are 15 factors used in this study. The case study is applied in the education field. Educators, technologists, and legislators all need to work together to guarantee the safe and effective use of wearable devices in schools, as shown by the study's findings. The article reiterates the importance of wearables and their potential to enhance safety measures in education before making the case for more studies, pilot programmers, and policy development to fully realize their promise.

Keywords: Wearable Technological Devices; MCDM; Neutrosophic Set; Safety and Security

1. Introduction

Recently, wearable technological gadgets have been widely available as potent resources for bolstering individuals' security and health. Sensors, networks, and data analytics have all come a long way in recent years, and these gadgets now provide novel approaches to old problems. Wearables have the potential to revolutionize the way we protect ourselves and reduce hazards in a variety of settings, from personal safety to occupational safety and health monitoring. In an effort to improve safety, this study will examine the history, current state, and potential of several wearable technological gadgets[1], [2].

Smartwatches, activity trackers, and personal safety alarms are just a few examples of the many wearable gadgets that have opened the way for new approaches to keeping people safe. This section describes the wide variety of wearable devices now on the market and the unique safety-oriented characteristics of each[3], [4].

Wearable gadgets are now able to monitor and analyze vital safety-related information thanks to the integration of modern sensors, networking options, and data analytics. This paragraph discusses the technology such as GPS, biometric sensors, and environmental sensors that enable wearables to gather and analyses data.

Personal safety, job security, and health monitoring are just a few of the areas where wearable technology may make a difference. This paragraph delves into the many fields where wearables are having a major influence and presents concrete examples of their safe use[5], [6].

Wearable technology offers exciting prospects for enhancing safety but also presents obstacles that must be overcome. Potential restrictions and challenges are discussed, including privacy concerns, data security threats, user acceptability, and technological restraints[7], [8].

The newest innovations in technology may make wearable gadgets a viable option for managing occupational education and safety in actual workplace settings. Workplace scenarios include the use of wearable technology, including improved guidance for seeing and responding to potential safety problems, keeping tabs on productivity, promoting health and wellbeing, and enhancing task management. Using real-time data describing and monitoring of one's physical and environmental conditions, risks may be immediately discovered and countered. Expert operators may also access and analyze the data produced[9], [10].

Comfort and, for some, personal taste, play a role in how one dresses for work. For others, wearing the appropriate gear on the job on a regular basis can mean the difference between staying comfortable and completing a shift safely in high-risk situations such as those involving heavy machinery, high voltage, or constant harsh environments. This research treats the question of where people are most likely to make use of wearable technologies among mining, construction, textile, agriculture, and chemistry—as a decision-making issue. CRITIC was used to determine the relative importance of each criterion[11], [12].

2. Wearable Technological Devices

The use of technology wearables for the sake of security and health improvement is on the rise. Some wearable gadgets that enhance security include the following:

GPS tracking, emergency SOS buttons, and fall detection are just a few of the safety features available on modern smartwatches. In the event of an accident or medical emergency, they may notify the appropriate parties.

Wearable safety alarms are small, portable gadgets that when triggered, sound an audible alert or distress signal. They may be clipped onto clothes, used as jewelry, or carried on key rings to provide a visible deterrent to possible attackers.

There are now fitness trackers available with built-in safety measures. In the event of an aberrant or disturbing situation, they may transmit notifications to predetermined contacts or emergency services about the wearer's heart rate, location, and activity levels.

Small GPS-enabled gadgets may be clipped onto items or worn by people to monitor their whereabouts in real-time. The elderly, the young, and those with cognitive disabilities may all benefit greatly from their usage.

Whether you're out bicycling, skiing, or working on a construction site, having a helmet that has sensors and connection functions may help keep you safe. They may measure collision forces, identify accidents, and notify designated people or authorities.

Some pieces of jewelry, such as necklaces and bracelets, include concealed alarms or panic buttons for added security. In the event of an emergency or dangerous circumstance, these gadgets allow their users to contact others or the authorities[13], [14].

Some forms of smart clothing include integrated safety features like sensors to track heart rate, core temperature, and even ambient variables. If the wearer is in danger or their predetermined contacts are, they may get warnings or notifications.

Wearable safety glasses with cameras and augmented reality (AR) capabilities may improve workplace safety in a number of ways, including the delivery of real-time safety instructions, the identification of potential hazards, and the provision of remote support.

Wearable air quality monitors may detect pollutants, allergies, and particulate matter in the air. Helping people make educated judgments about their surroundings and avoiding possible health concerns, they give real-time input on air quality.

Smart insoles are sensor-equipped shoe inserts that track wearers' movement, weight distribution, and balance. They are especially helpful for the elderly or those with mobility difficulties since they may detect falls or changes in movement habits.

While wearable technology has the potential to improve safety, it cannot replace common sense, vigilance, and the implementation of established protocols in the event of an emergency. Users should constantly evaluate their unique situations, do appropriate research, and choose security tools that meet their individual demands[15], [16].

3. Challenges and Risks of Wearable Technological Devices

There are many positive aspects to using wearable technology equipment, but there are also certain hazards and difficulties to think about. Some typical difficulties and dangers of using wearable technology are as follows:

Data Privacy and Security Biometric data, GPS coordinates, and activity logs are just a few examples of the types of private information collected and stored by wearable devices. Privacy leaks, unwanted access, and security holes are all things to worry about when it comes to storing, transmitting, and processing this kind of sensitive information. Protecting user information and using strong encryption and security measures are essential for lowering vulnerability[15], [17].

Precision and dependability Accurate and reliable sensors and algorithms in wearable devices are crucial to their usefulness. False alarms, misinterpretations, and weakened security are all possible outcomes of inaccurate or inconsistent data. Maintaining accuracy and dependability requires rigorous testing and validation methods, as well as ensuring the reliability and calibration of sensors.

Adoption and adherence from users are crucial for the success of wearable technology. Comfort, aesthetics, usability, and perceived advantages are all elements that might affect user acceptability and adherence. Critical difficulties include overcoming human reluctance, establishing user-friendly interfaces, and resolving concerns about comfort and social acceptability.

Limited battery life and charging time are two issues that might interrupt the uninterrupted use of many wearable gadgets. Particularly in circumstances calling for prolonged monitoring or prompt reaction, users may find it difficult to keep track of battery life and charge their devices on time. Research is continuing towards both increasing battery efficiency and investigating potential other power sources.

Wearable technology often functions as part of a wider ecosystem, connecting with other hardware, software, and service providers. Integration of wearables with preexisting infrastructure or third-party systems may be complicated by concerns such as compatibility, lack of standardization, and interoperability. These problems may be solved by advocating for open standards and streamlining integration procedures[13], [14].

Concerns about data ownership, user permission, and the inappropriate use of personal data are only some of the ethical issues that arise from the widespread use of wearable technologies. Complying with relevant laws and preserving user rights might be complicated by the fact that legal frameworks and regulations may differ among countries. To solve these issues, it is crucial to develop ethical norms, comply with privacy legislation, and encourage openness.

Although wearable technology is designed to improve security, it also has the potential to increase the risk of injury or illness. Issues with comfort and safety might arise when devices don't fit well, cause skin irritation, or trigger allergies. To reduce these hazards, it is important to ensure correct design, adhere to safety regulations, and undertake rigorous risk assessments.

Wearable technologies have limited contextual awareness since they depend heavily on sensor data to understand the user's context and give appropriate insights or warnings. However, they may lack full awareness of their surroundings, leading to missed alerts or false positives. The gadgets' ability to recognize and respond to user context requires further development of contextual sensors and intelligent algorithms.

Technology creators, academics, politicians, and end-users must all work together to address these problems and hazards. By proactively addressing these issues, we can maximize the safety advantages of wearable devices while also protecting user privacy, data security, and happiness[15], [16].

4. Wearable Technological Devices in Education

There are a variety of wearable technology gadgets that might be used to increase school safety. Some wearable gadgets and the tasks they can do are listed below.

Wearable technology, namely smartwatches with GPS tracking features, may be used to keep kids safe on school field trips and other outdoor excursions. They let teachers and parents track pupils' whereabouts in real-time and respond quickly to any safety concerns[18], [19].

Location trackers are tiny gadgets or ID cards that may be affixed to a student's clothes or bag to monitor their whereabouts. These trackers update their locations constantly, making it easy for teachers to find pupils and check on their well-being, even in densely populated areas or on expansive campuses.

Wearable panic buttons or personal safety alarms provide an additional layer of protection for students and faculty. Pressing the panic button immediately notifies the school's administration or security team of the incident, allowing them to react quickly and effectively.

Biometric Sensors Students' heart rates and temperatures, among other vitals, may be tracked using biometric sensors included in wearables. These sensors may pick up on irregular behavior or warning indications, allowing for preventative measures to be taken in the event of an emergency.

Wearable cameras, such as body cams used by teachers or security guards, may improve transparency and accountability in the workplace. Aside from serving as visual proof in the event of a dispute or inquiry, they may also be used to record instances and dissuade prospective wrongdoing[19], [20].

In the event of an emergency or other urgent scenario, staff members may quickly and easily communicate with one another via the use of wearable communication devices, such as smart headsets or earpieces. They allow for rapid communication, coordination, and action to address safety concerns among students.

Wearables with environmental sensors can track ambient conditions in classrooms, such as humidity, temperature, and noise. These sensors can monitor the surroundings for dangers like poor air quality or too much noise, and then inform teachers or provide other suggestions to keep the classroom safe.

It's worth noting that there should be regulations, standards, and training programs in place before wearable gadgets are introduced into the classroom. Protecting students' anonymity and personal information while encouraging their responsible usage of wearable devices requires addressing legitimate concerns about data security and ethics[21], [22].

5. CRITIC Methodology

Attribute weights are often calculated using the CRiteria Importance Through Intercriteria Correlation (CRITIC) technique, first suggested by Diakoulaki, Mavrotas, and Papayannakis in 1995. A matrix of choices relative values to each characteristic, and the process ensures that no two attributes are at odds with one another. This section integrated the CRITIC method with the single-valued neutrosophic set. The single-valued neutrosophic set consists of three values such as truth, indeterminacy, and falsity membership degrees. The single valued neutrosophic set is used to deal with uncertain data in the evaluation process. This method is used to compute the weights of factors under single-valued neutrosophic numbers[23], [24]. Figure 1 shwos the steps of the proposed method.

5.1 Build the decision matrix

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} \quad (1)$$

Where $i = 1,2,3, \dots, ;$ (alternatives) $j = 1,2,3, \dots, n$ (criteria)

5.2 Normalized Decision Matrix

In this step, we define the cost and benefit criteria.

$$n_{ij} = \frac{a_{ij} - a_i^-}{a_i^+ - a_i^-} \tag{2}$$

$$n_{ij} = \frac{a_i^- - a_{ij}}{a_i^- - a_i^+} \tag{3}$$

Where $a_i^- = \min a_i$ refers to the cost criteria and $a_i^+ = \max a_i$ refers to the beneficial criteria.

5.3 Compute the correlation coefficient

$$CC_{jk} = \frac{\sum_{i=1}^m (a_{ij} - a_j^-)(a_{ik} - a_k^-)}{\sqrt{\sum_{i=1}^m (a_{ij} - a_j^-)^2 \sum_{i=1}^m (a_{ik} - a_k^-)^2}} \tag{4}$$

$$a_k^- = \frac{1}{n} \sum_{j=1}^n a_{kj} \tag{5}$$

5.4 Compute the index

$$d_j = \sqrt{\frac{1}{n-1} \sum_{j=1}^n (a_{ij} - a_j^-)^2} \tag{6}$$

$$X_j = d_j \sum_{k=1}^n (1 - CC_{jk}) \tag{7}$$

5.5 Compute the weights of factors

$$w_j = \frac{x_j}{\sum_{j=1}^n x_j} \tag{8}$$

5.6 Rank the factors

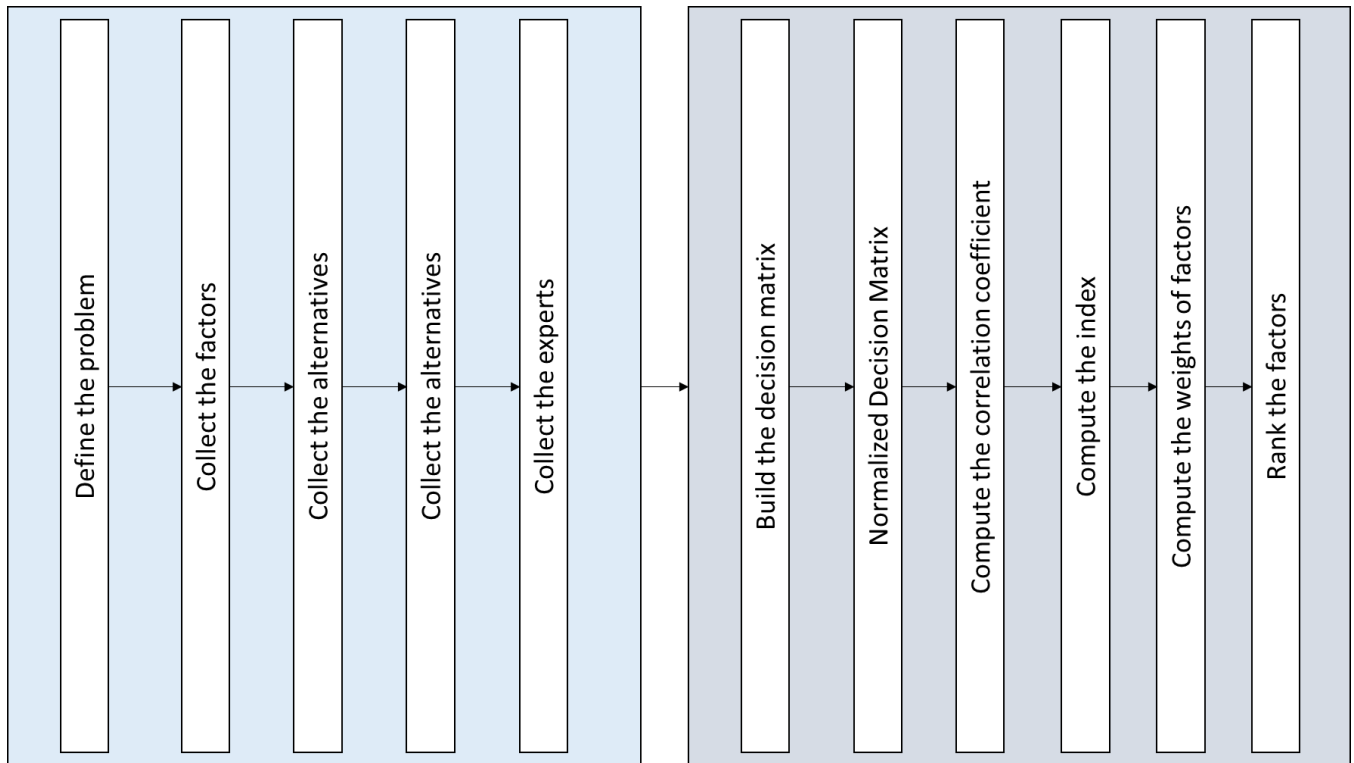


Figure 1: The steps of CRITIC method.

6. Application

The use of technology wearables for the sake of security and health improvement is on the rise. This section introduces the ranking of the factors in technology wearables. The CRITIC method is used to compute the weights of criteria and rank the factors.

The success of technology wearables in attaining safety depends on a number of things. Key considerations include the following:

Dependability: Wearable technology must reliably and consistently carry out its intended safety functions. For safety reasons, they need to offer precise measurements and monitoring of critical data including location, vital signs, and environmental variables.

Establishing and maintaining a reliable connection between wearable devices is essential for the transmission of data and warnings. The timely and effective transmission of emergency alerts or distress signals to specified contacts or authorities depends on dependable connection, which may be achieved using Bluetooth, Wi-Fi, or cellular networks.

Wearable gadgets, particularly those designed to increase safety, need batteries that last a long time. Continuous monitoring and accessibility in times of crisis call for devices that can run for long stretches of time without needing to be recharged often.

Usability: Even under high-pressure circumstances, people should be able to use wearable safety gadgets with ease. Quick activation of emergency alarms or safety functions may be facilitated by clear instructions, straightforward interfaces, and conveniently located buttons or features.

Wearable technology should be easy to put on and take off, and it should be pleasant to wear for long periods of time to encourage regular usage. Make sure the gadget can be used comfortably without creating any irritation by thinking about its weight, size, adaptability, and materials.

Safety equipment has to be robust enough to sustain normal use and be resistant to water in the event it becomes wet. For use in a variety of conditions, they must be sturdy, resistant to impact or shock, and preferably water-resistant or waterproof.

Strong data privacy and security safeguards are essential for wearable devices due to the collection and transmission of sensitive personal information. Encryption, safe data storage, and other safeguards against unauthorized access should all be standard on all devices.

Individuals have different requirements for, and preferences for, security. Adjustable settings, unique alarms, and the ability to sync with other apps and services are just a few examples of how wearables that can be tailored to the user's specific needs may better ensure their users' safety.

The efficiency of wearable devices may be improved by their capacity for seamless integration with current support systems including emergency response services, healthcare providers, and personal safety networks. Quicker responses, better-coordinated aid, and a more all-encompassing safety ecosystem are all made possible through integration.

Accessibility and Affordability It is crucial that wearable safety equipment be easily accessible and cheap for a broad range of users. More people who may benefit from safety gadgets will be likely to use them if they are reasonably priced. GPS Tracking Devices, Wearable cameras, Biometric sensors, Instruments of Interaction, and Sensing the Environment are factors of wearable technological devices in education.

Wearable technology equipment for safety may be effective, usable, and suitable for particular safety demands provided these considerations are taken into account throughout the selection process or during development.

We applied the steps of the single-valued neutrosophic CRITIC method to 15 factors in the education field.]

6.1 Build the decision matrix

We used Eq. (1) to build the decision matrix between factors and alternatives. This paper used ten alternatives in the field of education. The decision matrix is built by using single valued neutrosophic numbers.

6.2 Normalized Decision Matrix

All criteria are positive, so we normalized decision matrix by using Eq. (2) as shown in Table 1.

Table 1. The normalization of CRITIC method.

	WT DF ₁	WT DF ₂	WT DF ₃	WT DF ₄	WT DF ₅	WT DF ₆	WT DF ₇	WT DF ₈	WT DF ₉	WT DF ₁₀	WT DF ₁₁	WT DF ₁₂	WT DF ₁₃	WT DF ₁₄	WT DF ₁₅
WT DA ₁	1	0	0.79 487 2	0.7 175 0	0.05 010 9	0.73 701 8	0.03 691 8	0.24 719 1	0	0	1	0.00 125 0			
WT DA ₂	0.08 717 3	1	0.85 256 4	0.57 103 8	0.04 357 3	0.45 862 1	0.02 149 2	0.00 144 5	0.03 210 3	0.52 334 2	0.02 777 0	0.18 472 2	0.03 490 1		
WT DA ₃	0.24 906 6	1	0.85 256 4	0.28 142 1	0.00 871 5	0	0	0.02 889 2	0	0.19 656 1	0.00 347 4	0.00 136 0	0.03 535 7		
WT DA ₄	0.45 579 1	0.18 705	1	0.7 175 1	0.28 758 2	0.00 280 3	0.21 348 3	0.64 687	0.41 769	0.17 217 4	0.18 472 2	0.44 461 3			
WT DA ₅	0	1	0.17 307 7	0.7 175 5	0.62 841 976	0.09 310 3	0.17 634 5	0.21 348 3	0.02 728 7	0.52 334 2	0.68 787 9	0.30 583 3	1		
WT DA ₆	0.12 328 8	0.18 705	0.02 564 1	0.3 225 8	0.57 103 0	0.07	0.17 634 5	0.03 210 3	0.73 675 8	0.90 909 1	0.02 777	0.20 151 5	0.18 472 2	0.04 552 4	

WT DA ₇	0.09 464 5			0.7 175	0.28 142 1	0.04 422 7	0.45 862 1	0.16 348 7	0.21 348 3		0.24 57	0.17 911 7	0.03 030 3	0.18 472 2	0.03 490 1
WT DA ₈	0.78 331 3	0.16 546 8	0.00 576 9		0.57 103 8	0.28 976 8	0.06 413 8	0.53 677 7		0.52 327 4	0.24 57			0.64 166 7	0.20 030 3
WT DA ₉	0.12 328 8	0.04 964	0.11 538 5	0.3 25	0.57 103 8	0.04 357 3	0.45 862 1		0.44 462 3			0.18 467 1	0.03 030 3	0.45 416 7	0.33 884 7
WT DA ₁₀	0.28 642 6	0.18 705		1	0.25 409 8			0.43 398 7		0.24 719 1	0.19 656				0.84 370 3

6.3 Compute the correlation coefficient

The correlation coefficient is computed using Eqs. (4 and 5) as shown in Table 2.

Table 2: The correlation coefficient of CRITIC method.

	WT DF ₁	WT DF ₂	WT DF ₃	WT DF ₄	WT DF ₅	WT DF ₆	WT DF ₇	WT DF ₈	WT DF ₉	WT DF ₁₀	WT DF ₁₁	WT DF ₁₂	WT DF ₁₃	WT DF ₁₄	WT DF ₁₅
WT DF ₁		-	0.26	-	-	0.05	-	0.39	-	0.12	-	-	0.38	-	-
WT DF ₂	0.59		0.14	-	-	-	0.00	-	-	-	-	0.39	-	-	-
WT DF ₃	0.26	0.14		-	-	-	0.36	-	-	-	-	-	0.12	-	-
WT DF ₄	0.00	0.07	0.05		-	0.53	-	0.62	-	-	-	0.27	0.32	0.16	0.53
WT DF ₅	0.30	0.02	0.10	0.25		0.02	0.68	-	-	0.44	-	0.30	-	0.04	0.28
WT DF ₆	0.05	-	-	0.53	-		-	0.06	0.83	-	-	0.03	-	0.84	0.72
WT DF ₇	-	0.00	0.36	0.68	-		-	-	0.28	0.26	0.03	-	-	-	-
WT DF ₈	0.39	-	-	-	-	0.06			0.28	0.52	0.13	-	0.26	0.35	0.03
WT DF ₉	-	-	-	0.62	-	0.83	-	0.28		0.11	2.52	0.02	-	0.77	0.65
WT DF ₁₀	0.12	-	-	-	0.44	-	0.28	0.52	0.11		0.64	-	-	-	-
WT DF ₁₁	-	-	-	-	-	-	0.26	0.13	2.52	0.64		0.20	-	0.01	0.06

WT	-	0.39	-	0.27	0.30	0.03	0.03	-	0.02	-	0.20		0.40	-	0.67
DF ₁	0.42	609	0.18	887	890	377	493	0.12	724	0.20	882		207	0.04	357
₂	325	7	148	8	1	6	7	923	9	949	4	1	5	256	3
WT	0.38	-	0.12	0.32	-	-	-	0.26	-	-	-	0.40		-	0.10
DF ₁	445	0.11	954	688	0.39	0.15	0.38	959	0.21	0.20	0.24	207		0.34	983
₃	4	947	4	3	611	336	296	4	863	084	256	5	1	89	8
WT	-	-	-	0.16	0.04	0.84	-	0.35	0.77		0.01	-	-		0.59
DF ₁	0.02	0.34	0.61	117	400	573	0.18	051	382	0.22	986	0.04	0.34		417
₄	112	867	971	2	9	3	903	3	2	003	4	256	89	1	7
WT	-	-	-	0.53	0.28	0.72	-	0.03	0.65	-	0.06	0.67	0.10	0.59	
DF ₁	0.26	0.01	0.29	381	034	887	0.03	251	625	0.02	663	357	983	417	
₅	856	203	775	5	7	1	179	7	4	463	2	3	8	7	1

6.4 Compute the index

The index is computed by using Eqs. (6 and 7) as shown in Table 3.

Table 3: The index of CRITIC method.

	WT DF ₁	WT DF ₂	WT DF ₃	WT DF ₄	WT DF ₅	WT DF ₆	WT DF ₇	WT DF ₈	WT DF ₉	WT DF ₁	WT DF ₁	WT DF ₁	WT DF ₁	WT DF ₁	WT DF ₁
										0	1	2	3	4	5
WT		1.59	0.73	1.00		0.94	1.18	0.60	1.20	0.87	1.59	1.42	0.61	1.02	1.26
DF ₁		261	845	552	1.30	365	307	333	918	743	549	325	554	112	856
₀		1	1	1	608	2	8	7	3	7	8	2	6	5	1
WT	1.59		0.85	1.07	1.02	1.24	0.99	1.66	1.26	1.78	1.12	0.60	1.11		1.01
DF ₂	261		663	661	875	537	958	942	207	532	888	390	947	1.34	203
₁	0		3	5	8	4	4	1	8	4	1	3	5	867	4
WT	0.73	0.85		1.05		1.30	0.63		1.39	1.22	1.29	1.18	0.87	1.61	1.29
DF ₃	845	663		319	0.89	217	265	1.36	758	198	175	148	045	970	775
₁	3	0		8	462	4	5	32	6	6	8	2	6	6	2
WT	1.00	1.07	1.05		1.25	0.46		1.01	0.37	1.22	1.35	0.72	0.67	0.83	0.46
DF ₄	552	661	319		883	307	0.98	307	487	395	741	112	311	882	618
₁	5	8	0		4	5	16	6	9	3	6	2	7	8	5
WT		1.02		1.25		1.02	0.31	1.32	1.11	0.55		0.69	1.39	0.95	0.71
DF ₅	1.30	875	0.89	883		524	747	550	736	279	0.45	109	610	599	965
₁	608	8	462	4	0	3	7	1	1	4	437	9	5	1	3
WT	0.94	1.24	1.30	0.46	1.02		1.15	0.93	0.16	1.06	1.29	0.96	1.15	0.15	0.27
DF ₆	365	537	217	307	524		778	468	883	278	153	622	336	426	112
₂	4	4	4	5	3	0	6	2	7	5	5	4	1	7	9
WT	1.18	0.99	0.63		0.31	1.15		1.23		0.71	0.73	0.96	1.38	1.18	1.03
DF ₇	307	958	265	0.98	747	778		281	1.03	088	877	506	295	902	179
₈	4	5	16	7	6	0	9	341	2	5	3	7	9	1	
WT	0.60	1.66		1.01	1.32	0.93	1.23		0.71	0.47	0.86	1.12	0.73	0.64	0.96
DF ₈	333	942	1.36	307	550	468	281		098	345	015	922	040	948	748
₇	1	32	6	1	2	9	0	7	3	8	8	6	7	3	
WT	1.20	1.26	1.39	0.37	1.11	0.16		0.71		0.88	0.99	0.97	1.21	0.22	0.34
DF ₉	918	207	758	487	736	883	1.03	098		736	997	275	862	617	374
₃	8	6	9	1	7	341	7	0	6	5	1	6	8	6	
WT	0.87	1.78	1.22	1.22	0.55	1.06	0.71	0.47	0.88		0.35	1.20	1.20		1.02
DF ₁	743	532	198	395	279	278	088	345	736		211	948	083	0.77	462
₀	7	4	6	3	4	5	2	3	6	0	6	8	6	997	7
WT	1.59	1.12	1.29	1.35		1.29	0.73	0.86	0.99	0.35		0.79	1.24	0.98	0.93
DF ₁	549	888	175	741	0.45	153	877	015	997	211		117	256	013	336
₁	8	1	8	6	437	5	5	8	5	6	0	6	3	6	8

WT	1.42	0.60	1.18	0.72	0.69	0.96	0.96	1.12	0.97	1.20	0.79		0.59	1.04	0.32
DF ₁	325	390	148	112	109	622	506	922	275	948	117		792	255	642
₂	2	3	2	2	9	4	3	8	1	8	6	0	5	6	7
WT	0.61	1.11	0.87	0.67	1.39	1.15	1.38	0.73	1.21	1.20	1.24	0.59		1.34	0.89
DF ₁	554	947	045	311	610	336	295	040	862	083	256	792		890	016
₃	6	5	6	7	5	1	7	6	6	6	3	5	0	1	2
WT	1.02		1.61	0.83	0.95	0.15	1.18	0.64	0.22		0.98	1.04	1.34		0.40
DF ₁	112	1.34	970	882	599	426	902	948	617	0.77	013	255	890		582
₄	5	867	6	8	1	7	9	7	8	997	6	6	1	0	3
WT	1.26	1.01	1.29	0.46	0.71	0.27	1.03	0.96	0.34	1.02	0.93	0.32	0.89	0.40	
DF ₁	856	203	775	618	965	112	179	748	374	462	336	642	016	582	
₅	1	4	2	5	3	9	1	3	6	7	8	7	2	3	0

6.5 Compute the weights of factors

Then compute the weights of factors by using Eq. (8) as shown in Figure 2.

6.6 Rank the factors

Then rank the factors by the weights as shown in Figure 2. Factor 2 is the best and factor 5 is the worst.

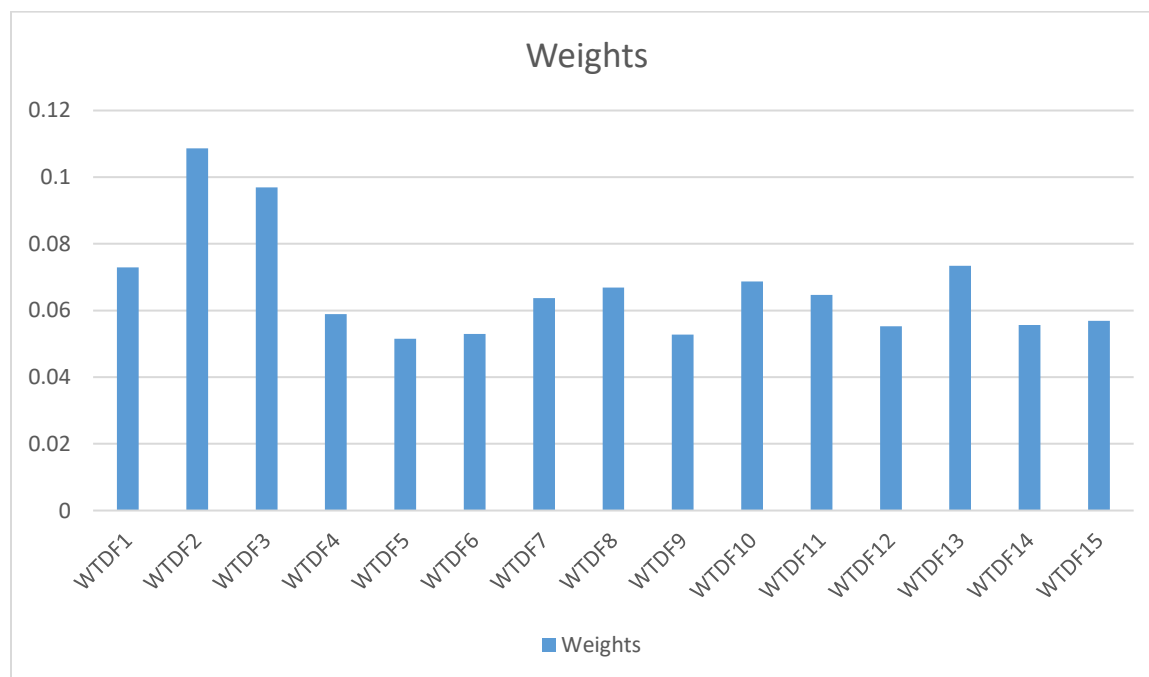


Figure 2: The weights of factors of wearable technological devices

7. Conclusions

In recent years, wearable technologies have developed as potentially useful instruments for ensuring safety in a variety of settings. Personal safety and security, workplace safety, health monitoring, and emergency response are just a few of the areas where wearables are having a major influence, as shown by the findings presented in this article. Wearables may gather and analyze crucial safety-related information, allowing for timely alarms and individualized insights, thanks to the integration of sophisticated sensors, networking choices, and data analytics. But before wearable technology can reach its full potential, a number of obstacles and dangers must be overcome. The need for

comprehensive measures to secure private user information is still at the forefront of privacy and data security concerns. Concerns including battery life, integration, and interoperability, as well as the accuracy, dependability, and user acceptability of wearable devices, must be addressed. This paper used the MCDM tools such as the DEMATEL method to rank and evaluate the criteria of wearable technological devices to achieve safety and security. The DEMATEL method is integrated with the single-valued neutrosophic set to deal with uncertain data. This paper used 15 factors of wearable technological devices to rank them.

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