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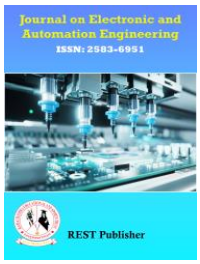

Automation and Remote Monitoring by using TOPSIS Method

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Abstract. *Our lives have grown less manual and easy as a result of the advancements in technological advances that has been caused by the Internet of Everything' daily growth. Considering the fact that health is currently one of the most critical topics, it might be used as a continuous monitoring system in the health care industry. Additionally, a phone call or online communication service can be enabled to let the doctor, medical assistant, and patient's family members know how the patient is feeling as well as allow the patient to speak with them. Automation is the use of technology to carry out operations or tasks with the least amount of human participation. It includes improving processes, decreasing errors, and increasing output via the use of hardware, software, and control systems.automation and remote monitoring is vast and impacts various industries and domains. Automation reduces manual labor and streamlines processes, leading to increased efficiency and productivity. Automation helps organizations reduce costs associated with labor, energy consumption, maintenance, and waste. Automation and remote monitoring enhance workplace safety by automating hazardous tasks, reducing human exposure to dangerous environments, and enabling real-time monitoring of safety-critical systems. Remote monitoring enables continuous data collection and analysis of equipment performance, environmental conditions, and operational parameters. Automation and remote monitoring are critical research areas that drive innovation, efficiency, safety, and sustainability across industries. Continued research and development efforts in automation and remote monitoring hold the potential to address emerging challenges, improve operational performance, and create value for organizations and society as a whole. TOPSIS, This method determines the physical distance across every possible solution by using both the negative and positive ideal scenarios as references values. The fundamental tenet of TOPSIS is that the performance criteria are assumed to be ascending, with higher numbers denoting superior performance. In order to accommodate different dimensions or scales between the criteria, the process of normalization represents a common making decisions tactics used by the TOPSIS design, assisting in picking the best choice from an assortment of possibilities. It weighs several factors and ranks options according to how close we are to the most suitable option. Alternatives in the TOPSIS are evaluated according to how far away they are from an unfavorable solution and just how close you are to the ideal answer. Alternative parameters taken as Functionality and Features: Ease of Integration, Reliability and Availability, Customization and Flexibility, Usability and User Experience, Cost and ROI Evaluation parameters taken as Edge Computing, governing bodies, Sensor Networks, Machine Learning and AI,(approximately Cloud-Based Solutions. TOPSIS for final result of TOPSIS for the data set for Automation and Remote Monitoring of the Ease of Integration got the first rank whereas Reliability and Availability had the lowest rank.*

1. INTRODUCTION

IoT could be used in the health sector as a continuous monitoring system, since heath is one of the most pressing issues these days. Strict safeguards, such as scanning fingers and password protection, can further increase the reliability of the system by preventing confusion and challenge. Following the deletion of particulars that are personally identifiable from the data, such as the patient's name, relevant diagnoses and medication are identified from text reports through NLP, or natural language processing, techniques [1]. When used to remotely observe patient, information sent by devices needs to be viewed as an element of the medical record of the individual. It also

needs to be integrated using clinical data from EMRs (electronic medical records) to facilitate real-time medical decision-making. We agree that the initial usage of implant and communicative devices for the tracking of patients and therapy is represented by CIEDs .Thanks to automatic appliance supervision and assistance products and services, home automation enhances quality of life [2].The development of a system for home automation using a cheap embedding CPU with a GSM/GPRS unit is covered in this section of the book. Various communication protocols are used to interface the sensors. The primary objective of remote surveillance is to manage and operate home automation systems by remotely (via the Internet) or locally (through a neighborhood network) tracking the current condition of appliances. Thanks to automated appliance control and assistive services, automation in the home improves quality of life [3].The various components of the automated remote monitoring system, such as component-based degradation examination, operational anomaly detection, the modeling of performance approach, and data instrumentation. The entire spectrum of data collecting, data processing, mechanical state tracking algorithms, alarm working with, problem analysis, diagnostics, and improvement suggestions are all included in remote monitoring of the health of a combined cycle power plant. The on-site monitor (OSM) data is continuously instrumented and collected in real time via sensors that are mounted on the equipment and management system on the power plant in remote performance tracking of a whole plant and its component health [4].In this regard, there are several studies examining the significance of efficient energy and environmental management of the building in the global literature. Integrated building automation systems are used as a control tool for lighting, ventilation, air conditioning and heating, and other building industry automation. They also provide remote and real-time energy usage monitoring. The operation of the suggested tool, in particular, is predicated on the optional installation and use of an automated system of sensors and meters for monitoring the energy consumption of the building and the combination of control scenarios, in order to reduce energy consumption and maximize energy rationalization [5].Numerous researchers have invented automated systems. However, such a system is relatively expensive to install and operate. Created a web-based Java-based home automation system the embedded system board ports that were attached to the home PC server allowed control over the household appliances. Created a wireless home automation system by combining speech recognition, the Internet, and GSM connection technologies. Speech recognition was created for users inside the home, while GSM and internet technologies were utilized for remote access to household electronics [6].In conclusion, automation and remote monitoring are complementary technologies that are vital to promoting safety, dependability, and efficiency in a variety of industries.

2. MATERIALS AND METHOD

Alternative parameters: Functionality and Features: Ease of Integration, Reliability and Availability, Customization and Flexibility, Usability and User Experience, Cost and ROI

Evaluation parameters: Edge Computing, governing bodies, Sensor Networks, Machine Learning and AI, (approximately Cloud-Based Solutions.

Functionality and Features: To tell the two apart, functionality refers to how well a software system's features really function, whereas features are the tools you use within a solution to accomplish a set of tasks.

Ease of Integration: The term "ease of integration" describes how easily and effectively a new technology, system, or software may be integrated into an existing infrastructure or environment without causing major disruptions or necessitating major changes. The new system or technology should be compatible with existing systems, platforms, and protocols. The new system should offer customization options and configuration settings that accommodate varying integration requirements and preferences. Overall, prioritizing ease of integration during the selection and implementation of new systems or technologies can help organizations streamline operations, improve efficiency, and accelerate innovation while minimizing disruption and mitigating risks.

Reliability and Availability: Whereas availability seeks to enhance operating time, reliability seeks to reduce system faults and downtime. One way to assess a grocery self-checkout system's service quality is to look at how frequently consumers need help from a clerk to finish a transaction. Keep in mind that availability and reliability are not the same. While availability gauges how frequently a system is accessible for usage, even when it might not be operating as intended, reliability measures a system's capacity to operate correctly, including preventing data corruption.

Customization and Flexibility: Customization and flexibility are essential concepts in various domains, including software development, product design, and business operations. Here's what each term generally means. v. Both concepts are crucial for delivering personalized experiences, optimizing efficiency, and fostering innovation across various industries and domains.

Usability and User Experience: When it comes to the design and development of systems, software, and user interfaces, "usability" and "user experience (UX)" are closely complementary ideas. However, they represent distinct aspects of how users interact with and perceive these products usability focuses on the practical aspects of how easily users can accomplish tasks within a product or system, while user experience encompasses the broader emotional and perceptual dimensions of the user's interaction with the product. Both usability and UX are crucial considerations in the design and development process to create products that are both functional and enjoyable to use.

Cost and ROI: When assessing the financial performance and viability of investments, initiatives, or commercial activities, "cost" and "return on investment (ROI)" are crucial financial measures. Below is an explanation of each idea. The term "cost" describes the whole sum of money, materials, or labor needed to purchase, create, carry out, or sustain a project, service, project, or activity. A financial term called return on investment (ROI) is used to assess how profitable and efficient an investment is in relation to its cost. It calculates the percentage difference between the net profit or benefits of an investment and the initial investment cost. While cost refers to the out-of-pocket costs associated with carrying out a specific project or investment, ROI gauges the monetary gains made in comparison to the initial outlay. Both

Edge Computing: Edge computing is a distributed computing paradigm that moves data storage and computation closer to the "edge" of the network, or the place where they are needed. Edge computing seeks to process data closer to the source or the end users than typical cloud computing models, which store and process data in centralized data centers. This close proximity lowers latency, maximizes bandwidth utilization, and improves the general performance of services and applications—particularly those that demand low-latency or real-time processing. By extending processing capabilities closer to the data source, edge computing is an emerging technological paradigm that enhances cloud computing and allows for faster reaction times, better scalability, and increased reliability for a variety of applications and services.

Governing bodies: Organizations, institutions, or other entities with the power to enact and uphold laws, rules, and policies within a particular territory or domain are referred to as governing bodies. These organizations are essential for upholding law and order, advancing public welfare, and guaranteeing adherence to established norms. They are able to function on a number of levels, encompassing local, regional, national, and worldwide. In order to advance the general welfare, preserve law and order, and preserve norms of behavior and accountability, these governing bodies impose regulations, exercise authority, and supervise activity within their particular purviews.

Sensor Networks: Networks of interconnected sensors that collect, process, and send data from the real world to different applications or processing units are called sensor networks. These networks are essential in many industries, including as industrial automation, healthcare, smart cities, and environmental monitoring. They can be deployed on a local or big scale. Real-time data gathering, analysis, and decision-making across multiple domains are made possible by sensor networks, which enhance productivity, sustainability, and quality of life. Sensor networks are predicted to become more important in forming our linked environment as technology develops and the Internet of Things (IoT) ecosystem grows.

Machine Learning and AI: Though they have different features and uses, machine learning (ML) and artificial intelligence (AI) are closely connected topics that cross and complement one another. Artificial intelligence is the term used to describe computer systems that simulate human intelligence processes. Applications of artificial intelligence (AI) can be found in many fields, such as virtual assistants, recommendation engines, self-driving cars, automated trading systems, gaming, medical diagnostics, and more. A branch of artificial intelligence known as "machine learning" focuses on creating statistical models and algorithms that let computers learn from data and make judgments or predictions without needing to be explicitly programmed for a given task. Machine learning is a subset of artificial intelligence that focuses on algorithms, whereas artificial intelligence (AI) is the larger term that includes the emulation of human intelligence by machines.

Cloud-Based Solutions: Cloud-based solutions refer to software, services, and resources that are delivered over the internet from remote servers maintained by cloud service providers. These solutions leverage the cloud computing model to provide on-demand access to computing power, storage, databases, applications, and other IT resources without the need for on-premises infrastructure or hardware investments. Examples of cloud-based solutions include Software-as-a-Service (SaaS) applications, Platform-as-a-Service (PaaS) offerings, Infrastructure-as-a-Service (IaaS) platforms, cloud storage services, and cloud-based development environments. Popular cloud service providers include Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), IBM Cloud, and Alibaba Cloud. Overall, cloud-based solutions enable organizations to innovate, scale, and drive digital transformation by leveraging the benefits of cloud computing.

Method: The negative solution shows the lowest possible values, while the ideal solution shows the best possible values for each criterion. The decision matrix, which comprises of options and their related performance on several criteria, must first be defined in order to use TOPSIS [7]. The values within the matrix are then standardized by using normalization. The relative relevance of each criterion is then reflected in the construction of the weighted normalized decision matrix. The ideal and negative solutions are identified following the construction of the weighted normalized choice matrix. The negative solution is made up of the lowest-performing values, whereas the ideal solution is made up of the highest-performing values for each criterion. The relevant distance measures typically the Manhattan or Euclidean distances are used to compute the distances between each option and these solutions [8].Finally, the relative closeness of each alternative to the ideal solution is assessed by computing the similarity measure. Alternatives with higher similarity to the ideal solution and lower similarity to the negative solution are considered preferable. In summary, TOPSIS provides a systematic approach for decision-making by considering both the ideal and negative solutions, and evaluating alternatives based on their proximity to these solutions across multiple criteria. TOPSIS provides a systematic approach for decision-making by considering both the ideal and negative solutions, and evaluating alternatives based on their proximity to these solutions across multiple criteria [9]. Modern TOPSIS methodology aims to efficiently select alternatives that are significantly close to the optimal solution while being noticeably distant from the worst-case scenario solution, achieved through the application of an effective and advanced ranking mechanism known as TOPSIS. When a superior response falls short, it results in a price increase, whereas an improved response from a superior broadens the criteria for advantages while narrowing down the criteria for price. The utilization of the TOPSIS technique is based on comprehensive attribute records, encompassing essential FMCDM properties, two fuzzy membership activities, the TOPSIS algorithm, and a data collection spreadsheet. The application of Harmony, as mentioned in a previous study, helps resolve overlapping usages [10]. TOPSIS is regarded as an efficient approach for achieving optimal regulatory performance. This method involves analyzing, contrasting, and evaluating various possibilities. Building on this foundation, the current study aims to expand TOPSIS's application to real-world group decision-making scenarios focused on assignments. The study outlines a comprehensive and successful selection method. The operation of TOPSIS is then concluded. The study initially examines the impact of the Weighted Euclidean (EW) approach on decision-making and evaluation processes, considering various statistical data and theoretical judgments. TOPSIS serves as an additional metric due to its unique characteristics, such as reduced components, increased stability, and a range of response values that capture various shifts in value, making it a more advantageous alternative to heuristics [11]. The decision to develop TOPSIS was made [16]. It does this by providing a numerical example involving randomly generated issues of various magnitudes for calculation. This method involves a comprehensive comparison of preference ranking sequences, considering factors like the consistency ratio, odds ratio of ideal alternatives, and average Pearson correlation coefficients. The first aspect addresses the relationship between two variables, while the second assesses the impact of measurements by comparing hypothetical outcomes to the mean count of coefficients [12]. This method utilizes regression on rows. The compromise programming system introduces the concept of "Proximity to Ideal," which considers two criteria: "majority" and "minimum," aiming to maximize "group utility" for each grievance. These distance metrics are employed to determine solutions in the TOPSIS strategy, which effectively addresses both short-term and long-term challenges.. One critique is that it was adapted for addressing multi-objective decision-making (MODM) issues without adequately accounting for the relative importance of specific criteria or the problem's nature.

3. RESULTS AND DISCUSSION

TABLE 1. Automation and Remote Monitoring

	Edge Computing governing bodies	Sensor Networks	Machine Learning and AI (approximately	Cloud-Based Solutions
Functionality and Features	25.07	147.25	31.54	25.36
Ease of Integration	32.96	146.52	13.85	22.31
Reliability and Availability	28.34	123.33	48.23	28.32
Customization and Flexibility	35.04	127.54	42.80	29.56
Usability and User Experience	52.84	167.52	75.65	23.32
Cost and ROI	15	32	25	10

Table 1 shows Automation and Remote Monitoring for TOPSIS method Alternative parameters: Functionality and Features: Ease of Integration, Reliability and Availability, Customization and Flexibility, Usability and User Experience, Cost and ROI Evaluation parameters: Edge Computing, governing bodies, Sensor Networks, Machine Learning and AI,(approximately Cloud-Based Solutions.

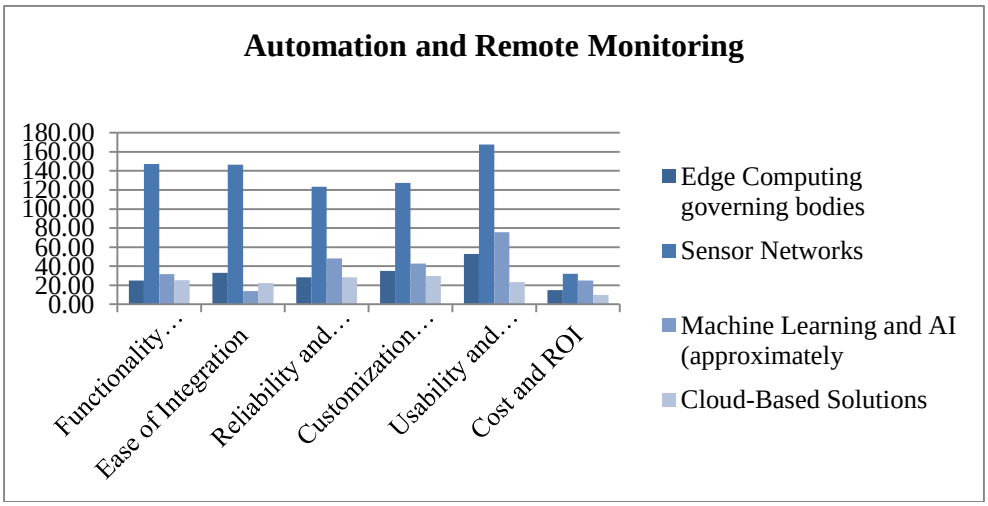

FIGURE 1. Automation and Remote Monitoring

Figure 1 shows the data set for Automation and Remote Monitoring for Analysis using the TOPSIS Method. Functionality and Features: Ease of Integration, Reliability and Availability, Customization and Flexibility, Usability and User Experience, Cost and ROI Alternative value, and ROI Evaluation parameters: Edge Computing, governing bodies, Sensor Networks, Machine Learning and AI, (approximately Cloud-Based Solutions

TABLE 2. Normalized Data

	Edge Computing governing bodies	Sensor Networks	Machine Learning and AI (approximately	Cloud-Based Solutions
Functionality and Features	0.3049	0.457	0.2917	0.4311
Ease of Integration	0.4008	0.455	0.1281	0.3793
Reliability and Availability	0.3446	0.383	0.4460	0.4814
Customization and Flexibility	0.4261	0.396	0.3958	0.5025
Usability and User Experience	0.6425	0.52	0.6996	0.3964
Cost and ROI	0.1824	0.099	0.2312	0.1700

Table 2 shows the normalized data which is calculated from the data set each value is calculated by the same value on the table 1. Automation and Remote Monitoring divided by the sum of the column of the above tabulation.

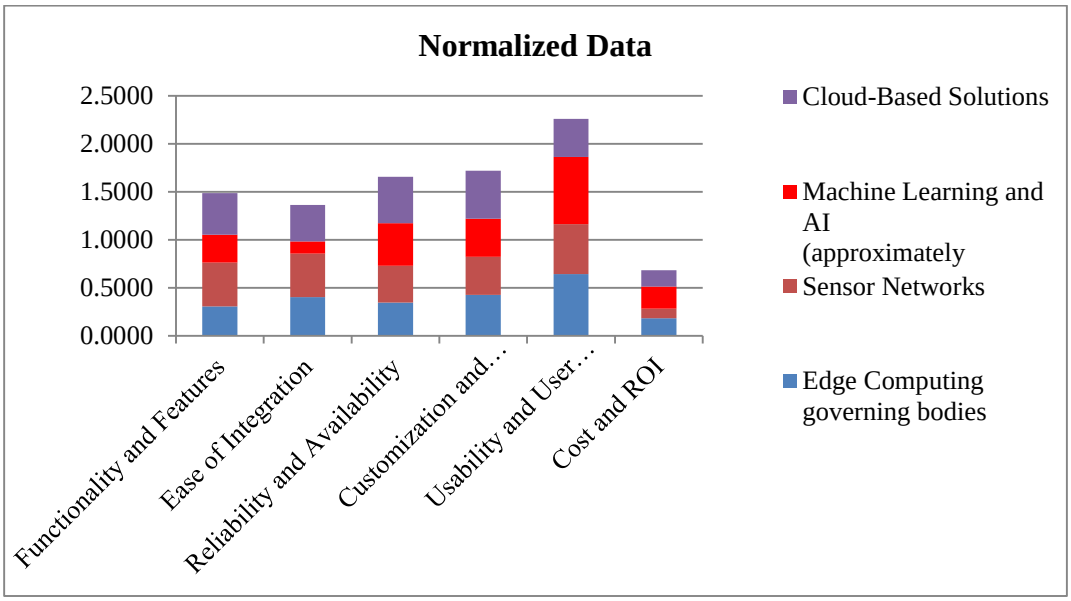

FIGURE 2. Normalized Data

TABLE 3. Weight

Weight			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 3 shows the Weight ages used for the analysis. We take the same weights for all the parameters for the analysis.

TABLE 4. Weight Normalized Decision Matrix

	Edge Computing governing bodies	Sensor Networks	Machine Learning and AI (approximately	Cloud-Based Solutions
Functionality and Features	0.3049	0.457	0.2917	0.4311
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Cost and ROI	0.1824	0.099	0.2312	0.1700

Table 4 shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 2 and table 3.

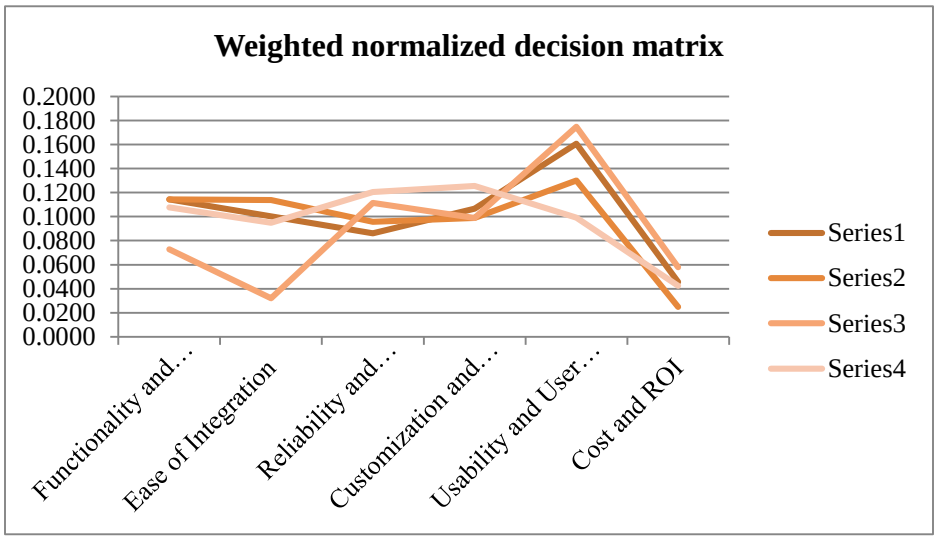

FIGURE 3. Weight Normalized Decision Matrix

TABLE 5. si plus and si negative and Min(Ci) and Rank

	SI Plus	Si Negative	Ci	Rank
Functionality and Features	0.0913	0.1531	0.6266	2
Ease of Integration	0.0816	0.1796	0.6876	1
Reliability and Availability	0.1382	0.1035	0.4283	6
Customization and Flexibility	0.1236	0.1224	0.4975	4
Usability and User Experience	0.1537	0.1581	0.5071	3
Cost and ROI	0.1580	0.1436	0.4761	5

Table 5 shows the final result of TOPSIS for the data set for Automation and Remote Monitoring of the Ease of Integration got the first rank whereas Reliability and Availability had the lowest rank.

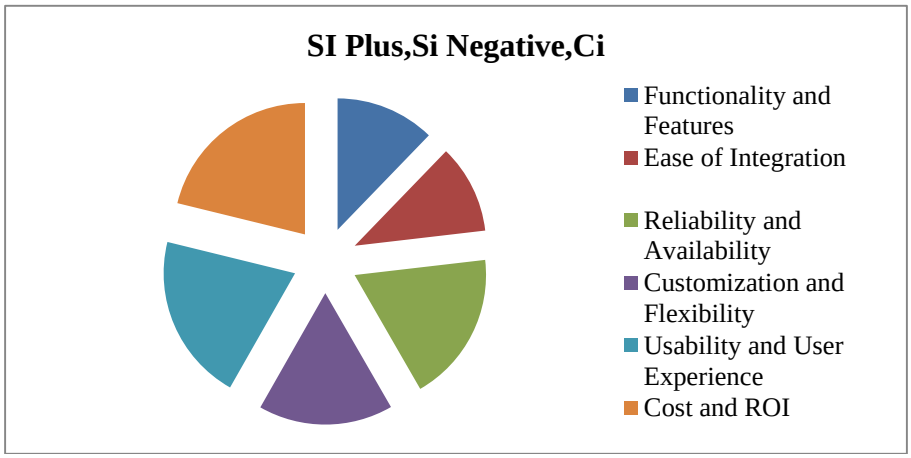

FIGURE 4. Result of Si Plus, Si Negative and Ci

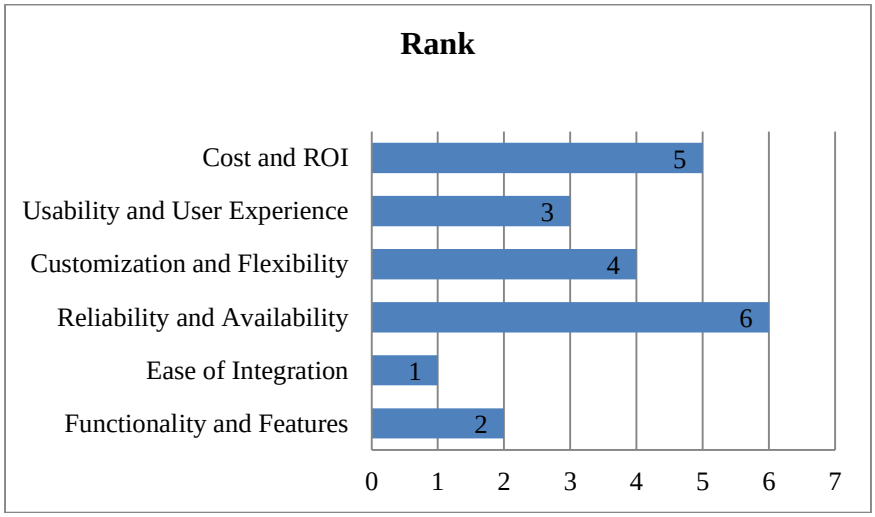

FIGURE 5. Result of Rank

Figure 4 shows the final result of TOPSIS for final result of TOPSIS for the data set for Automation and Remote Monitoring of the Ease of Integration got the first rank whereas Reliability and Availability had the lowest rank.

4. CONCLUSION

Additionally, a phone call or online communication service can be enabled to let the doctor, medical assistant, and patient's family members know how the patient is feeling as well as allow the patient to speak with them. Automation is the use of technology to carry out operations or tasks with the least amount of human participation. It includes improving processes, decreasing errors, and increasing output via the use of hardware, software, and control systems. Automation and remote monitoring is vast and impacts various industries and domains. Automation reduces manual labor and streamlines processes, leading to increased efficiency and productivity. Automation helps organizations reduce costs associated with labor, energy consumption, maintenance, and waste. When used to remotely observe patient, information sent by devices needs to be viewed as an element of the medical record of the individual. It also needs to be integrated using clinical data from EMRs (electronic medical records) to facilitate real-time medical decision-making. We agree that the initial usage of implant and communicative devices for the tracking of patients and therapy is represented by CIEDs .Thanks to automatic appliance supervision and assistance products and services, home automation enhances quality of life.The negative solution shows the lowest possible values, while the ideal solution shows the best possible values for each criterion. The decision matrix, which comprises of options and their related performance on several criteria, must first be defined in order to use TOPSIS. This method utilizes regression on rows. The compromise programming system introduces the concept of "Proximity to Ideal," which considers two criteria: "majority" and "minimum," aiming to maximize "group utility" for each grievance. These distance metrics are employed to determine solutions in the TOPSIS strategy, which effectively addresses both short-term and long-term challenges. One critique is that it was adapted for addressing multi-objective decision-making (MODM) issues without adequately accounting for the relative importance of specific criteria or the problem's nature. The final result of TOPSIS for final result of TOPSIS for the data set for Automation and Remote Monitoring of the Ease of Integration got the first rank whereas Reliability and Availability had the lowest rank.

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