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Selection of Industrial Robots Problem Using Complex Proportional Assessment (COPRAS) Method

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Abstract

Industrial Robot is continuously moving assembly line Intensive production required by to automate tasks A created one. Big, as heavy robots, they are a At standard conditions within an industrial plant are placed, and other All labour works Processes also revolve around them. Obvious robots too Common industrial robots. They are like human hands Looks, that's what they are Robotic arm or manipulator Also called hand. Many There with degree of independence Accents are obvious weapons Allow a wide range of motion.Industrial robots functional quality, Safety and productivity Improve almost every production Also widely used in companies. Nature of work to be done Depending, there are many types of robots now Commercially from different manufacturers are available. analysis of the COPRAS method in this complex proportional estimation (COPRAS) system in 1994 zavadskas, kaklauskas and sarka introduced by this time index values increase and decrease used to estimate. Alternative: ASEA-IRB 60/2, Cincinnati Milacrone T3-726, Cybotech V15 Electric Robot, Unimation PUMA 500/600, United States Robots Maker 110, Yaskawa Electric Motoman L3C.Evaluation preference: repeatability, memory capacity, manipulator reach, load capacity, maximum tip speed. The result it is seen that Cybotech V15 Electric Robot is got the first rank where as is the ASEA-IRB 60/2 is having the lowest rank.

Keywords: Industrial Robot, Automation , COPRAS method

Introduction

Industrial Robotics Programmable mechanical devices They replace humans are used because they are repeated with extreme precision or Able to perform dangerous tasks.In manufacturing industrial robotics Many parts go. These robots Making cables, small parts, grippers, Security and many other elements are used. Industrial Robotics A great industry and that changing rapidly. The last few Technology has been dramatic over the decades The method has changed, as well Size and variety of deployments There are also types. Industrial Robotics For those new to the field, a Finding the starting point It may seem difficult. of automation Detailed information on types and benefits Overview Industrial Robotics Technology and growing Industrial robots in the field of robotics The reason has changed the manufacturing sector They come with many downstream benefits. Their first and most important the advantage is their efficiency. They are Tasks faster than physical labor finish, and their work Time is significantly longer. Speed and runtime The combination is low operating cost leading to higher performance. Industrial robotics is a Automation is technology, which is approx Substantial since 1960 received attention. This Development of industrial robotics in the sector, Design of Robot Manipulator and methods of programming robots will be discussed. In human form If not, flexible behavior machines with and Some human-like physical characteristics Developed for industry. First Standard industrial robot is a programmable unimat, It is electronically controlled A hydraulic heavy-lifting arm, It can repeat spontaneous movements.

Industrial robot selection

An industrial robot is about 100 Can be described by technical data. 33 important to describe robots Suggests a list of parameters. Among these factors are mechanical and control Performance parameters, industry Installation, Operation of Robots and Maintenance and cost factors including Industrial robot The selection process is multifaceted The process is carefully planned want The purpose of the user is an industry Select the robot and its characteristics Aimed at the robot Meets the needs of the job [1]. Industrial Robot Selection, A subjective and objective combined multi-attribute decision making For robot selection purpose proposed in this paper. This method of attribute importance of objective weights and attributes Combined Important weights Subjectivity of the decision maker judge Considers options. Also, quality To convert attributes to quantity attributes The method uses fuzzy logic [2]. Ratio analysis and reference point A selection of two real-time industrial robots are explored using problems. Single dimensional and high dimensional both weights are weighted in sensitivity analysis In order to study the effects of variations are done, And six rankings of the considered MCDM strategies is the most important criterion of sustainability [3]. Criteria weights or decision maker without considering the options Based on cross competencies in DEA An industrial robot selection method. Seven technical requirements and four alternatives Considering robots, industry Integrated for solving robot selection problems AHP and Quality Function Deployment (QFD)

methods. This example is for some pick-n-place operations a highly suitable industrial robot Choosing, there are certain obstacles to avoid. Performance of business robot often stated using distinctive attributes [4]. An industrial robot is a commonplace one Purpose, a few anthropological factors A reprogrammable device with Its mechanical arm is very crucial and The important anthropological aspect is Other much less however nevertheless Important capabilities, its selection-making Capacity, for numerous sensory inputs Responsiveness and with different machines Various consisting of speaking It is vital for commercial packages turns into instrumental. Welding. Control Resolution, Accuracy, Repetitive capability, load bearing capability, Degrees of freedom, guy-machine Interface functionality, programming flexibility, max Node velocity, memory capacity and Supplier's service excellent is enterprise trendy Consider when selecting a robotic These are the most essential attributes to have [5]. Industry over the past two decades the use of robots has increased dramatically. By 1985, 16,000 in the United States Industrial robots are installed, and forecasts continue to develop 1571. Led to growth each will provide multiple models of robot manufacturers Increase in number. Industry with applications to robotics A decision maker (DM) is diverse Many have performance and costs between robot models Faced with a choice [6]. Industry between 2018 and 2020 14% YoY in robot installations predicts an increase. And 1.7 by 2020 A new industry of more than million Robots around the world It is predicted to be installed in factories 3 million units. This is optimistic The Benedicts are those of Israel. Stronger-than-expected growth Faster business cycles, customer various classifications in demand, As well as the concept of "Industry 4.0". Appearance and expected are supported by measurement [7]. To improve the performance of organizations Robots in industrial workstations are widely used. Reduce delivery time, Improve work environment and productivity Reduce costs, market demand Increase product range, again Re-manufacturing Robots are used to do this. for time. Many for a given application A selection of robots is made If so, their performance Comparing properties in the correct fashion necessary of Industrial Robot Among the key performance criteria Some drive systems, Geometry manipulation, Path measuring systems, robotics Material, load carrying capacity, speed, of robotic Weight, programming flexibility, of the robotic Scale and accuracy of the robot[8]. MADM theory is weighted Overall performance ranking The method is short-listed Better than efficient alternatives The robot was used to get the exam result. Adopted DEA-based Appropriateness of approach and To demonstrate uniqueness, Two real-time Industrial robot selection problems have been additionally addressed. The desire of industrial robotic is lengthy overdue MCDM is considered as a hassle. So much for choosing a suitable robot Decision Making Tools and Techniques The literature depicts that have been explored[9]. To perform a specific task Industrial robot work and robotics depends on relevant criteria. Materials treated by means of robots are powder, Like adhesive, cumbersome, brittle are specific. In this way, a specific Available to handle the item From a collection of industrial robots Choosing the right robot a challenging task. Very conscientious To get a decision, a There are many decision makers in a decision making system There are Interval value intuition Reluctance vague set of individuals To express reluctant thought Used as an efficient mathematical tool[10]. Hence, a given industry An Industrial Robot for Applications When selecting, the decision maker is all this attributes are subjective and objective advantages and consider cost attributes to take, whereas for them For robot performance measures A trade-off between is actually felt. required. For robot selection methods, Productivity Optimization models, computer aided models and Includes statistical models[11]. Industrial robots functional quality, Safety and productivity improve almost every production Also widely used in companies. Nature of work to be done Depending, there are many types of robots now Commercially from different manufacturers are available. Designed work In order to be effective, many of the industrial robot Functional properties are also simultaneous Responsible. Therefore, appropriate and A competitive robot Safety and productivity Choosing is a dilemma for decision makers And becomes an equally challenging task. of Industrial Robot Evaluation and Selection Several criteria are used to overcome this problem A robust model of decision-making is required[12]. Vendor Selection Problem But, As far because the authors understand, industry Robot Choice is not in the field. All attribute through this technique To deal with dimensional problems as well Easy and strong decision making A sample can be obtained. Specifically, this The approach is conventional robotic A weighted sum will decide rather than to expert judgments[13]. Different robots have corresponding abilities And there are specifications. A specific application and For industrial needs, the robot Seems to be less sensitive. Correct and appropriate selection It is a difficult task. Multiple robot selection There are methods. Industrial robot Consider research assignments on the exam With, team for the right choice of robots The best-worst method is in this paper has been used. of decision makers Consider past experience weighing them down with Expert and reliable robot is an important factor considered for selection[14]. Painting, and welding A ability robotic person now A huge range of alternatives going through Choosing which robotic to use could be very complicated, Because of the excessive range of robot performance Specified through the parameters, for this There aren't any enterprise standards yet. In this text, industrial-robot choice We gift a selection version for the problem. Identify the best performing robots Strong Mahala Nobis far and wide to see This includes principal components analysis Using the model. identified Robots manufacturer's specifications Can be tested to verify. The proposed model is Previously used for the robo-selection problem 27 Specifications for Industrial Robots In a real data set containing Tested and results are presented[15]. Choosing an Industrial Robot Basically an MCDM problem, Many of these include assessment and evaluation Includes codes. Most Rating indices are subjective in nature Because of that, difficulty. In this context, Application of fuzzy logic, said end Suitable for supporting modeling. From the literature, an obscure compendium The theory has a wide range of applications contains and database obfuscation It is widely used for handling, Because it is with the subjective judgment of humans Ambiguity of related concepts and helps to deal with ambiguity[16]. AC servomotors are high power Industrial robot to operate heavy loads are widely used in manipulators Hence, the right choice of motors And the control excels at specific tasks Contributes to performance. In this paper, Optimal Selection of Synchronous AC Servomotors and multi simultaneously for control Objective Dynamic Optimization Method proposed. Three objective functions, Energy consumption, monitoring error and gross weight of motors are optimized [17]. Assembling industrial robots such as welding and painting A wide range of applications have For these applications As best

point-to-point motion manage is needed, the give up-effector of the robotic is aspecific path to follow Not necessarily, of the given points To move between sets. For this In contrast, milling applications are continuous request route control because Tool path accuracy is mechanized Shape and dimension of part Affects accuracy[18]. Economic evaluation and industry Variety of robots to choose from Although proposed, given Which of the following is an industrial robot selection problem MADM method is better Still unclear. This paper Both are based on priority dominance Considering methods, given So much for industrial applications Suitable industrial robots Their comparison while choosing Benchmarking compares performance. Four performance tests are also conducted[19]. Mechanical industrial robots are widely used in Operations, And they may be step by step conventional Compete with CNC machining facilities. Precision of robot joints Obtaining stiffness values is a large cut For deflection compensation during forces is the foundation. Many factors contribute to joint stiffness affect the accuracy of identification[20].

Complex Proportionality Assessment (COPRAS)

Complex proportionality assessment (COPRAS) the weighted mean and geometric integration operators integrate the pifss information. Then, to solve the decision problems COPRAS and integration operators basically two algorithms we create. +e COPRAS method zavadskas and introduced by many. Every compare alternative and benchmark weights taking into account their calculating priorities. In all such methods, to rank the given alternatives one of the most suitable methods COPRAS is and quantity and broadly to qualitative analysis is used. +e direct and proportional dependence of the COPRAS method weights and study on the structure of criteria use of adaptations made considers size. COPRAS method is engineering problems in computation time means less, more basic, good a comparative analysis of methods transparency and their graphical about co-strategies greater possibilities of understanding indicates. Hajiaka et al in literature, various of cobras method in fuzzy environment there are many applications [21]. To enhance the evaluation efficiency of COPRAS, stochastic COPRAS (COPRAS-s) stochastic decision making named as complex using process proportionality rating (COPRAS) approach. In the COPRAS-s, scale significance performance of weights and alternatives a fixed number of values decision maker (dm) estimates minimum and maximum from a uniform distribution over a range of values by generating random numbers determined. Thus, the number of experts increased and different opinions because of the incorporation, the decision-making process done effectively. Additionally, with ambiguity at the end the resulting randomness is modeled in this manner.a unique normalization based on wellknown deviation the method is likewise implemented in COPRAS-s. In this manner, the cost and advantage category criteria are evaluated in a exclusive way. This proposed for cobras a practical and powerful tool [22]. Among these methods, cobras recent attracted more inquiries. As a compromise method, cobras method is better rate of settlement and worse of the ratio for the best solution basically determines a solution. Unlike other madm methods, the copras method is step-by-step dependent on rankings and reasoning importance to make selection and both application degrees uses. Chatterjee et al conducted comparative analysis, ahp, others like vikor and topsis compared to methods, copras-based the technique requires less evaluation time, very straight forward and graphical explanation also shows high reliability. In literature, cobras have many uses [23]. The COPRAS method is an MCDM approach, it changed into delivered through zavadskas et al. This method is a fine-ideal answer and one associated with the terrible-perfect answer determines the solution, consequently a compromise mcdm method can be considered. First, the COPRAS system under deterministic conditions created for decision making. Uncertainty in decision making is a as an inevitable feature, of cobras method in this study an extended form is proposed [24]. This section focuses on a new extension to the cobras method popular under phfs environment delivery. Origin of cobras method is mcdm led to increased use of copras in javadskas et al. Cobras method selected for the project using residential appliances. Zavatskas and many others. In an environment of uncertainty combined grey-cobras contractors rated with approach. Korabe et al. The copras approach using industrial robots a formal selection was made. Yastani et al. Green suppliers qfd and copras for evaluation with integrated model created by zheng et al. For reluctant linguistic preferences by using copras assessment of severity of lung disease did vahdani et al. Gap with the COPRAS approach valued in an ambiguous context robots. Mousavi et al. Comparison with other mcdm methods for selection of auxiliary equipment by performance of the COPRAS approach researched. Chatterjee et al [25]. Theoretically sustainable eligibility of city cell for small city to evaluate, several criteria complex proportions with of assessment system (COPRAS) application is provided. the parameters efficient calculation and city of visualizing the abstract for purpose this time geography linked to information system [26]. COPRAS method of information can be processed from different angles. Exacerbation in copraspatients indicators for assessment, the more they have values, patients better body status and price standards, the better the values they've, the poor bodily situation of sufferers which might be divided into benefit standards. Similarly, the cobras system is complex based on proportional calculation considering two criteria, this is much compared to other methods contains accurate information, the handling is cost criterion or this is a measure of goodness [27].To achieve the ranking of alternatives, the value of each attribute should also contain their values and operational requirements to evaluate alternative to complement a decision-making process should be used. Available attribute data size or can be qualitative. Contradictory decision making is influenced by criteria to solve a selection trouble in situations madm approach COPRAS is useful. Here, the situation of device selection COPRAS explained and up to date ranking is executed by method. Using the proposed method, the rank received is very found to be reliable [28].Introduction to Mcdm problems an integrated intuition fuzzy cobras (IF-COPRAS) method, an extension of the classical COPRAS method. In this manuscript, known as if-COPRAS method many with intuitively ambiguous information criteria decision making (Mcdm) difficulty solving problems we use the proportional assessment (COPRAS) method we provide in this manner, a to estimate scale weights a new formula has been developed, in which objective weights are from a different measurement system are calculated. For this, the new parameter difference and entropy measures there are some desirable

ones that have been explored properties are also discussed [29]. Complex proportionality assessment (COPRAS) by coefficient of gray number (COPRAS-g) methods complex proportionality assessment material selection using this article attempts to address the issues, different at the same time subject selection criteria and considering their relative importance takes these two methods rankings obtained using the past almost with those obtained by the researchers confirm. Of accepted methods feasibility and applicability two cases to prove time examples are illustrated [30].

Analysis and Discussion

The ASEA IRB is an industrial robot series for material handling, packing, transportation, polishing, welding, and grading. Built in 1975, the robot allowed. Design, automate and order custom robot cells in 3D in your browser. Customize your robot cell with, a pedestal, part presenter, range extender, area scanner. Cybotech robot systems are capable of handling painting, spot and arc welding, assembly, routing, drilling, and numerous other applications. Hitachi has developed a wide variety of robots that offer new value to customers. · EMIEW3 is a Human Symbiotic Robot that Actively Communicates with People. Called PUMA (Programmable Universal Machine for Assembly), they have been used since 1978 to assemble automobile subcomponents such as dash panels and lights. iRobot Corporation is an American advanced technology company that specializes in designing and building robots. The company's robotics suite of products includes the Roomba Vacuuming Robot from the home robot cleaning category.Yaskawa Motoman delivers high-quality industrial robots and fully-integrated robotic automation systems that enable our customers to succeed globally.

TABLE 1. Industrial Robot Selection

	repeatability	**memory capacity**	**manipulator reach**	**load capacity**	**maximum tip speed**
ASEA-IRB 60/2	2540.00	500.00	990.00	60.00	0.40
Cincinnati Milacrone T3-726	1016.00	3000.00	1041.00	6.35	0.15
Cybotech V15 Electric Robot	1727.20	1500.00	1676.00	6.80	0.10
Hitachi America Process Robot	1000.00	2000.00	965.00	10.00	0.20
Unimation PUMA 500/600	560.00	500.00	915.00	2.50	0.10
United States Robots Maker 110	1016.00	350.00	508.00	4.50	0.08
Yaskawa Electric Motoman L3C	1778.00	1000.00	920.00	3.00	0.10

Table 1 shows the Industrial Robot Selection using COPRAS method for ASEA-IRB 60/2, Cincinnati Milacrone T3-726, Cybotech V15 Electric Robot, Unimation PUMA 500/600, United States Robots Maker 110, Yaskawa Electric Motoman L3C.repeatability, memory capacity, manipulator reach, load capacity, maximum tip speed.

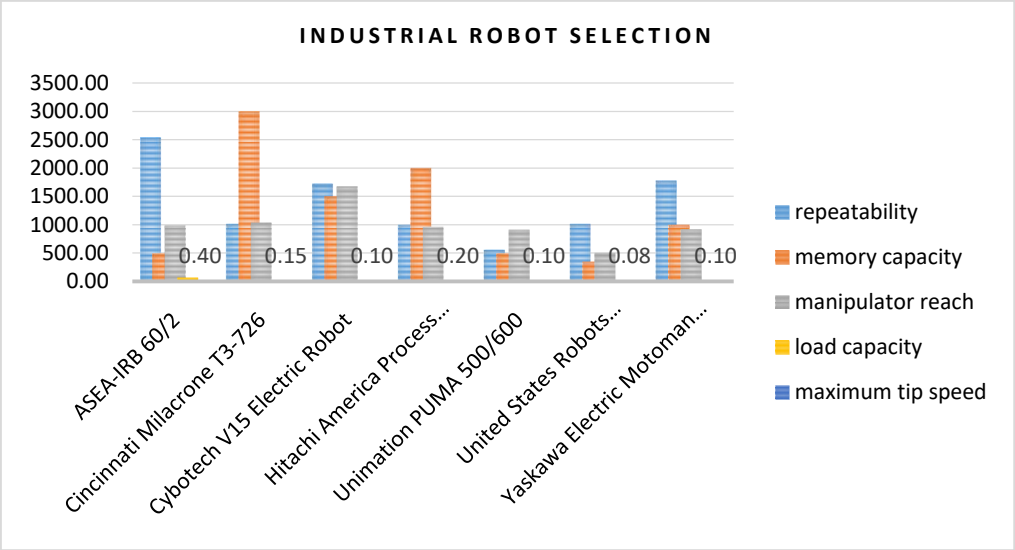

FIGURE 1. Industrial Robot Selection

Figure 1. Shows the industrial robot selection repeatability it is seen that ASEA-IRB 60/2 is showing the highest value for Unimation PUMA 500/600 is showing the lowest value. memory capacity it is seen that Cincinnati Milacrone T3-726 is showing the highest value for United States Robots Maker 110 is showing the lowest value. manipulator reach it is seen that Cybotech V15 Electric Robot is showing the highest value for United States Robots Maker 110 is showing the lowest value.

load capacity it is seen that ASEA-IRB 60/2 is showing the highest value for Unimation PUMA 500/600 is showing the lowest value. maximum tip speed it is seen that ASEA-IRB 60/2 is showing the highest value for United States Robots Maker 110 is showing the lowest value.

TABLE 2. Normalized Data

Normalized Data				
repeatability	**memory capacity**	**manipulator reach**	**load capacity**	**maximum tip speed**
0.2636	0.0565	0.1411	0.6441	0.3540
0.1054	0.3390	0.1484	0.0682	0.1327
0.1792	0.1695	0.2389	0.0730	0.0885
0.1038	0.2260	0.1376	0.1074	0.1770
0.0581	0.0565	0.1304	0.0268	0.0885
0.1054	0.0395	0.0724	0.0483	0.0708
0.1845	0.1130	0.1311	0.0322	0.0885

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. Industrial Robot Selection divided by the sum of the column of the above tabulation.

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	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 of the weight is equal for all the value in the set of data in the table 1. The weight is multiplied with the previous table to get the next value.

TABLE 4. Weighted normalized decision matrix

Weighted normalized decision matrix				
0.065891	0.014124	0.035282	0.161031	0.088496
0.026356	0.084746	0.037099	0.017042	0.033186
0.044806	0.042373	0.059729	0.01825	0.022124
0.025941	0.056497	0.034391	0.026838	0.044248
0.014527	0.014124	0.032609	0.00671	0.022124
0.026356	0.009887	0.018104	0.012077	0.017699
0.046123	0.028249	0.032787	0.008052	0.022124

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

TABLE 5. Bi & Ci& Min(Ci)/Ci

Bi	**Ci**	**Min(Ci)/Ci**
0.115296	0.249526	0.115553
0.148201	0.050228	0.57405
0.146908	0.040374	0.71416
0.116829	0.071086	0.405613
0.06126	0.028834	1
0.054347	0.029776	0.968334
0.107159	0.030175	0.955529
min(Ci)*sum(Ci)	0.014417	4.733238

Table 5 shows the value of Bi, Ci, Min(Ci)/Ci The Bi is calculated from the sum of the ASEA-IRB 60/2, Cincinnati Milacrone T3-726, Cybotech V15 Electric Robot, Unimation PUMA 500/600, United States Robots Maker 110, Yaskawa Electric Motoman L3C. The Ci is calculated from the sum formula used.

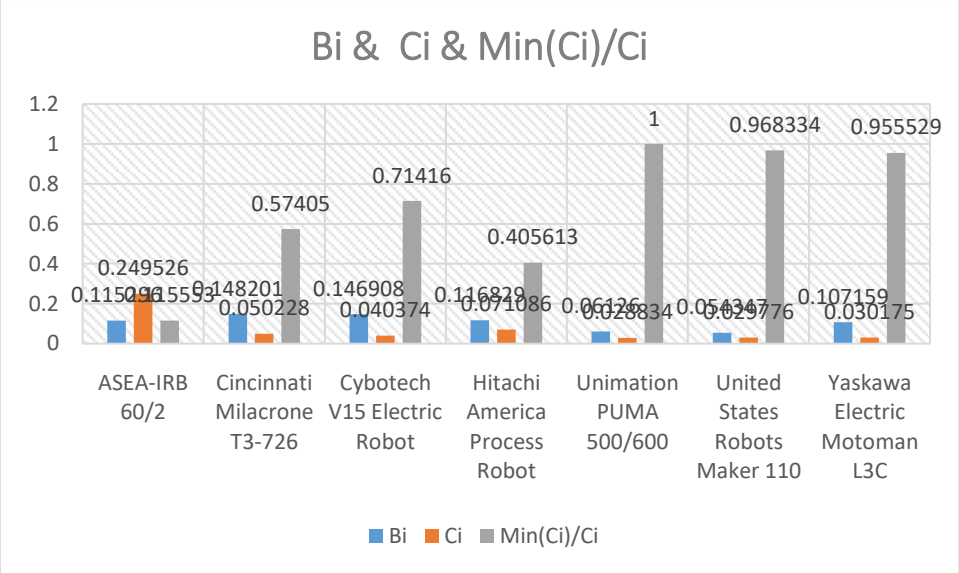

FIGURE 2. Bi & Ci & Min (Ci)/Ci

Figure 2 shows the value of Bi, Ci, Min(Ci)/Ci the Min Unimation PUMA 500/600 is showing the highest value ASEA-IRB 60/2 for is showing the lowest value.

TABLE 6. Qi & Ui & Rank

	Qi	**Ui**	**Ui**	**Rank**
ASEA-IRB 60/2	0.127503	57.34372	57%	7
Cincinnati Milacrone T3-726	0.208841	93.92521	94%	2
Cybotech V15 Electric Robot	0.222348	100	100%	1
Hitachi America Process Robot	0.159676	71.8135	72%	5
Unimation PUMA 500/600	0.166896	75.06053	75%	4
United States Robots Maker 110	0.156638	70.44712	70%	6
Yaskawa Electric Motoman L3C	0.208097	93.59049	94%	3

Table 6 shows the Qi & Ui & Ui % & Rank value Qi sum, minimum formulas using this table.the final result of this paper the ASEA-IRB 60/2 is in 7th rank, the final result of this paper the Cincinnati Milacrone T3-726 is in 2nd rank, the final result of this paper the Cybotech V15 Electric Robot is in 1strank, theHitachi America Process Robot is in 5th rank, the Unimation PUMA 500/600 is in 4th rank, the United States Robots Maker 110 is in 6th rank and the Yaskawa Electric Motoman L3C is in 3rd rank. The final result is done by using the COPRAS method.

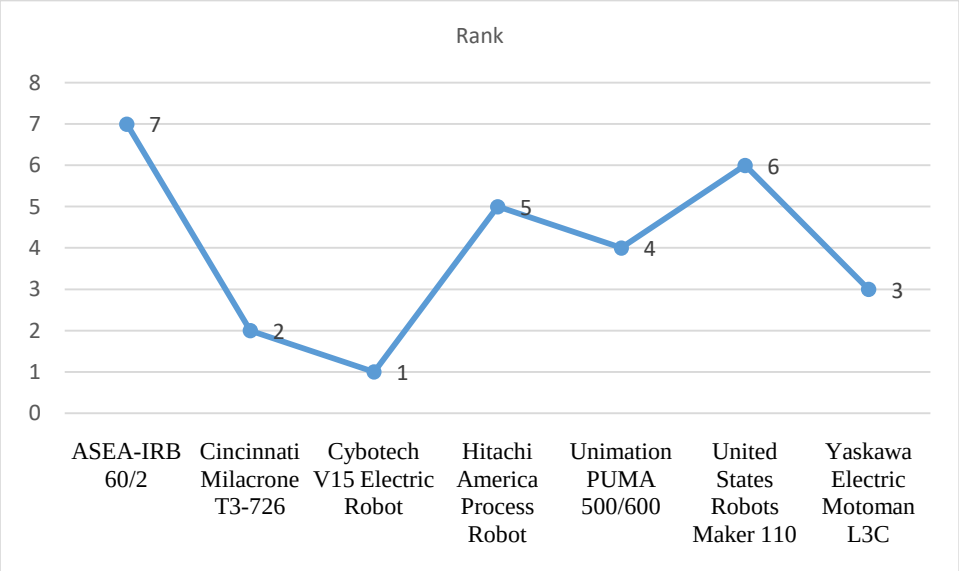

FIGURE 3. Rank

Figure 3 shows the graphical view of the final result the ASEA-IRB 60/2 is in Seventh rank, the final result of this paper the Cincinnati Milacrone T3-726 is in Second rank, the final result of this paper the Cybotech V15 Electric Robot is in First rank, the Hitachi America Process Robot is in Fifth rank, the Unimation PUMA 500/600 is in Fourth rank, the United States Robots Maker 110 is in Sixth rank and the Yaskawa Electric Motoman L3C is in Third rank.

Conclusion

An industrial robot is a in the production or processing line Specific functions and A that implements functions Sensors, controllers in transparent frame and autonomy of drivers is the system. called program As instructed by the set of commands They are repetitive motion cycles continue to function through Industrial robots are key Components are four of an industrial robot Key parts handler, Controller, human interface device and electricity. Therefore, position and Speed controllable servo A high-functioning motor For motor industrial robots is used. For operating actuators the most common source of energy is electricity, but hydraulic and pneumatic Energy can also be used. In this paper Cybotech V15 electric robot is ranked first, while ASEA-IRB 60/2 is ranked lowest.

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