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Micro Electro Mechanical Systems (MEMS): Fabrication Using DEMATEL Method

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Abstract. *microelectromechanical systems (mems): fabrication Introduction: Micro-electromechanical systems (mems) are mechanical and small for connecting electrical components and integrated devices or used to create systems a process is a technology. They are integrated circuits (ic). Batch processing techniques fabricated using a few micrometers to millimeters will be up to of the smallest machines energy, the technology that can create them appreciated before existence, for example, Richard Feynman's The famous 1959 lecture there is plenty of room at the bottom. Mems are modified semiconductor device fabrication using technologies once fabricated, the practice came electronics in general used for making, molding, and plating, wet etching (Koh, tmah), and dry etching machine (EDM) and small ability to manufacture devices other technologies with. Research significance: Micro-electro-mechanical systems or mems stands for technology, it's formed using microfabrication techniques in a general form small mechanical and electro mechanical components viz devices and structures can be defined as mems devices important physical dimensions at the lower end of the dimension spectrum many from below one micron varies up to millimeters. Likewise, mems device types, with no moving parts from very simple structures integrated microelectronics multiple moving components under control containing highly complex electro as far as mechanical systems vary. A core of mems the criterion is, at least some elements types of mechanical operations contain, these organs move can it or not? Define mems the term used is that of the world it varies in different regions. In the united states, they are mainly called mems, at the same time some other parts of the world in areas they are "microsystems technology" or "micro machines called devices". Functional components of mems miniaturized structures, sensors, and actuators, and although microelectronics, very remarkable and very interesting elements are micro-sensors and micro-actuators micro sensors and micro actuators are "transducers". Are properly classified as they are from a form of energy converted to another format and are defined as devices. In micro sensors, the device generally measured mechanical converts signal into an electrical signal. Methodology: the decision-making trial and evaluation laboratory (dematel) is regarded as an efficient technique for locating the causal links in a complex system. It focuses on assessing the interdependencies between elements and identifying the crucial ones using a visual structural model. Alternative: electrical, magnetic, mechanical, thermal, chemical Evaluation preference: electrical, magnetic, mechanical, thermal, chemical Results: from the result, it is seen that electrical got the first rank whereas the thermal is having the lowest rank. Conclusion: as can be seen, electrical has the lowest rating while thermal has the top rank.*
Keywords: *dematel, microelectromechanical, magnetic.*

1. INTRODUCTION

Micromachining and micro-electromechanical system (mems) technologies have complexity on the scale of micrometers structures, and devices and can be used to create systems. Initially, micromachining techniques directly integrated circuit (ic) credit from industry bought, but now many are unique mems-specific micromachining processes are created. In mems, a kind of real-world signals from one energy to another form different types to change transmission methods that may be used, through these various micro sensors, and micro actuators and can run microsystems [1]. Silicon carbide (sic) recently attracted mems, micromachining broad with processes this is a bandgap semiconductor fundamental of attention understanding is required. Microelectromechanical aggregate great for micromachining energy in 1970s systems (mems) was developed. Sic exhibits excellent electricity, as an extension of ic technology, mechanical and chemical properties create, it is three-dimensional creates structures. Traditional mems are made of silicon (si). Are constrained by physical limitations. Etch masks and etch this paper links with stops carving [2]. A microelectromechanical system, mems miniaturized electromechanical actuators, sensors, and microsystems combined electrical, mechanical, radiant, thermal,

and magnetic and refer to chemical e! acts. Icmems, imams or items, and cmos like mems many acronyms include micromachining, thin lm deposition, or with electrodeposition combined integrated-circuit (ic) based on technologies silicon integrated stands for mems. Called Lia (lithography # galvanoforming) [3]. Since its inception, the mems industry is a few products hundreds offerings pioneering grown, and they are being produced today. Mems devices industry activity, health care, consumer goods, construction, and military and aerospace all hardware areas are also used. A vibrant, growing mems industry is the industrialization of the world in countries. The product of this diversification of offerings and the globalization of industry is strong revenue growth Along with growing private investment has joined in 2004, all mems shipped devices valued at $4.55bn there was, this was around 2010 it is projected to rise to $12.52bn. Today, mems products profit from the sale, for innovation and product development government investment as the driving force transfer has started [4]. Micro sensors and micro in both actuator applications piezoelectric materials are silicon microelectromechanical are integrated with (mems) systems. The selection of thin film materials and processing routes are reviewed. Acoustic emission micro sensors, vibration monitors, molecular recognition biosensors, precision stabilizers, micro-pumps, and linear stepper piezoelectric including motors some recent and of mems a growing number of applications are offered [5]. Deposited thinner micromechanical from figs by creating structures surface micromachining is characterized. First for integrated circuits used, low-pressure chemical-vapor-deposition polycrystalline silicon, silicon nitride, and such as silicon dioxides a series of pictures made of objects deposited and selected may be disposed of in the manner or machine three-dimensional structures can be created. They are planar feet released from the molecule. To fulfill this fiction, the process dates back to the 1960s however, over the past few years it is rapid expansion and micromechanics and monolithic microelectromechanical systems (mems) for the set of applications is appropriate at this time surface micromachining reviews thoroughly [6]. Microelectromechanical systems (mems) in general integrated circuit (ic) made for industry based on lithography improvements in planar technologies fabricated using mems three-dimensional characterization is a computer design used by ic designer's aids is very different indicates. Specifically, three-dimensional visualization of structures and electromechanical programs that provide analytics for mems designers are very instant applications [7]. Micromachining is an emerging technology, it is mainly based on silicon small using materials scale microstructures traditionally macroscopic looking at the scale, as well micromachining techniques can only be created using new ¢lcctromechanical devices. Of such microscopic systems, development is precision engineering and integrated circuit especially for mass production important, recently created over the year's various fabrication techniques and design techniques, microelectromechanical systems (mems). Miniaturized leading to the production of devices [8]. Integrated micro sensors, micro actuators, micro instruments micro-optics, and microelectronics including accelerometers in applications deploying the airbag in the car; an ink-jet printer is a color projection movable mirrors for displays and for imaging atoms atom for transport also heads the studies. Micrometer/nanometer scale is a micro tool for us, with microscopic analytical instruments when combined, of biological molecules mechanical and chemical properties classification possibilities provides micro electro mechanical systems in general silicon as a structural material use, and devices conventional integrated-circuit are fabricated using technology [9]. With rf mems components and circuits, early in the design process, there are many conflicts to consider there may be requirements. For example, inherent performance inserts loss, isolation, and losses of revenue. Electrical, piezoelectric, magnetic, and electrical thermal control parameters voltage, current, power, residual energy, and momentum. Manufacturing technologies surface and aggregate machining [10]. They are small, versatile, inexpensive, and fast. Micro electro mechanical system (mems) devices are chemical and biological many areas of science quickly penetrability, and chemical and bioreactors are amazing new to do provide ways. Mems devices are integrated with both electrical and mechanical components connected they usually are micrometer scale and usually various combined circuit processing techniques fabricated using [11]. Recent technological developments promising in micromechanics engineering research opportunities priorities are also open. Resonators on the micron length scale, sensors, gears, and levers make machine parts without stimulating nerve cells to inject fluid into the organism also making small needles it is possible now [12]. For dynamically reliable mems design to develop guidelines as a first step, we machine we analyze a large class of shock-loaded microsystems response, and failure criteria creating. With elastic molecules as connected microstructures mems are designed, to the shocks over a period applied to the substrate are designed as pulses of acceleration. Relative time in the analysis quantities sound transit time, duration of vibration, and used duration of shock load [13]. Microelectromechanical system (mems) and nanoelectromechanical system (NEMS) based resonators and filters have been proposed at frequencies ranging from khz to ghz. Such stability of resonators how to measure with dimensions the question is, for noise characteristics emphasize this is explored in the thesis. Smaller is the dimensions of the resonator in contrast, on the macro-scale, there are very few device instabilities that become prominent [14]. Microsystem technologies of surface and bulk micromachining developments include miniature sensors, electromechanical components, and made actuators. With integrated circuits, they're combined in a single-chip microelectromechanical system (mems). Provided these miniature systems in principle existing measurement tools can be completely replaced, for example, spectrophotometers, and ellipsometers [15]. Microelectromechanical systems (mems). As a growing area of research, it is electronic at the micron scale with circuits and sensors movable mechanical parts make integration possible. Peterson (1982), "Silicon as a mechanical material". In the title, "micromechanics of basic, silicon, electronic with its usual role as object combined, already advanced microfabrication technology can be used. More accuracy, strength, and more reliable machines are also used as material, especially miniaturized mechanical devices and components to be integrated with electronics to have or be attached to [16]. High-energy-density plasma is typical of x-ray spectrometers used in

experiments a wide range of x-ray energies is required. X-ray background, debris, and mechanical shocks to overcome difficulties in security and high temporality, spatial and spectral resolutions. With a streak camera using an elliptical crystal by the way, in the sg-ii laser facility we solve this problem [17].

2. MATERIALS & METHODS

Evaluation preference: electrical, magnetic, mechanical, thermal, chemical

Electrical: Electrical engineering is electrical, electronics, and electromagnetism and will be used in equipment, fixtures and systems analysis, design, and with usage a related field is engineering. The electric telegraph, telephone, and power generation and distribution of use this is after commercialization late 19th century as an identifiable profession formed. Electrical engineering now computer engineering, systems engineering, power engineering, telecommunication, radio-frequency engineering, signal processing, instrumentation, photovoltaic cells, electronics and optics, and photonics as various fields including is separated. Hardware engineering, power electronics, electromagnetism and waves, microwave engineering, nanotechnology, electrochemistry, renewable energies, dynamics/control, and electrical materials science are many specialized sections including these fields include: along with many other engineering disciplines are connected. Electrical engineers in general electrical engineering or electronics graduates in engineering. Practicing engineers are professionals who may contain a certificate and a professional body or as members of the international standards organization may be. International electro technical commission (IEC), the institute of electrical and electronics of Engineers (IEEE), and the ins of engineering and technology (it) are among these.

Magnetic: Magnetism is caused by a magnetic field mediated physics is a class of attributes, which is in the organization's attraction and triggers aversive extent. Electric currents and magnetic moments of elementary particles create a magnetic field, it is other currents and acts on magnetic moments. Magnetism is the electromagnetism of integrated events is a feature. Very familiar effects on ferromagnetic materials occur, they are due to magnetic fields they become permanent magnets magnetized and magnetic fields create a magnet deletion is also possible. Few materials are only ferromagnetic; the most common are iron, cobalt, and nickel and their compounds. Rare-earth metals such as neodymium and Samaria are lesser common examples. Ferro-the prefix refers to iron, because of permanent magnetism originally found in lodestone.

Mechanical: Mechanical engineering is involving power and motion in physical machine research. It is engineering physics and mathematics principles with materials science combined, machine settings design, analysis, manufacturing and maintenance is an engineering division. This is a very ancient and vast field of engineering. Mechanics for mechanical engineering, mechanics, thermodynamics, materials science, design, structural analysis, and main including electricity understanding of areas needed. This basic in addition to policies, mechanical engineers' computer-aided design (cad), computer-assisted manufacturing (cam), and manufacturing life cycle management using tools like manufacturing plants, industrial equipment and machinery, heating, and cooling designing systems analysis. Transportation systems, aircraft, watercraft, robotics, medical devices, weapons, and others.

Thermal: The sun warms the earth, it is directly above and heats the air warm near the surface air expands, and surrounds becomes less dense than air. At high altitudes and low pressure lighter air due to expansion rises and cools. Surrounding density of air, for the same temperature it rises as it cools. Surrounding the heat column downward flow is accompanied by heat related to moving downwards the outside is at the top of the heat caused by the migration of cold air. The amount of heat and the strongest in the lower atmosphere (troposphere) is influenced by properties. When the air is cold, bubbles of hot air on the ground heat the air above its form and heated the air rises like a balloon. The wind is referred to as transient because it generates heat suitable. A warm layer on top if there is wind, a reverse prevents heat build-up and the air is constant it is said because mature heat cannot be generated. Visible isolation at the top of the thermal because of the presence of cumulus clouds heats are often indicated. Cumulus clouds, in the air vapor into visible droplets of heat until they start to condense formed by rising winds. When there is a steady wind, heats and their foci clouds are directed towards the direction of the wind and can be aligned in rows, some at times soar and glider "cloud streets" to pilots are referred to as.

Chemical: A chemical is defined as any containing compound subject. In other words, a chemical always by the same "stuff became something like water chemicals that occur in nature. For bleaching chlorine fabrics or used in swimming pools other chemicals such as chemicals are all around you the food you eat are your clothes to wear. You, indeed, by various types of became a chemical reaction occurs in a chemical indicates change. Very generally, a chemical reaction is for either one or more products and more different things as a process of creation and change can understand. Chemistry changes are from physical changes different, it's in stuff that doesn't make a difference. Water freezes for physical change during freezing an example. Snow is different although having physical properties, it is still water. Another example, you are a cup dissolving salt in water. Salt although it seems to disappear in the water, you still have water and salt is - any object not transformed into a new substance. As for chemical reaction here's an example: iron + oxygen → iron oxide. Also known as rust iron oxide, iron again or cannot be converted into oxygen. This is a completely new material. In the equation, to the left of the arrow items in the yard are considered reactions participating in a chemical reaction material. Right of the

arrow the object in the yard is a considered material that is the result of a chemical reaction with an object. In the reaction that the subject is not "lost note from this example it is necessary to of eq iron on one side and oxygen is present; on the other hand, you still have iron and there is oxygen now combined as a chemical.

Method: The DEMATEL method is a specific problem, pinup binding work through problems and a hierarchical structure contribute to identifying workable solutions structural modeling techniques, for one reason interrelationships between components of the organization identifying dependencies and basic concept of situational relations can affect and influence of elements causal charting uses direction charts. The DEMATEL system is integrated with emergency management together with manage. In the manner proposed, it is not necessary to defuzzify obscure numbers before using the DEMATEL method [13]. Built on the basic principle of DEMATEL, it executes issues by visualization method analyses and solves them. Modeling this structured approach adopts the form of a driven diagram, which is a causal effect for presenting values of influence between interrelated relationships and factors. By analyzing the visual relationship of conditions between systemic factors, all components are a causal group, and the effect is divided into groups. It also provides researchers with structure between system components better understanding of the relationship and complexity for troubleshooting computer problems can find ways [14]. The DEMATEL method effectively calculates the consequences between criteria, which efficiently separates the set of complicated elements right into a sender organization and a recipient institution and transforms it right technique to choosing a management gadget between alternate configurations explicit priority weights come from, in addition, the zogp model allows companies to make full use of limited resources for planning to implement optimal management systems [15]. Therefore, decision-makers need to determine obstacles to the legal framework are strong and make sure it is controllable to minimize impact or influence barriers. Therefore, derived from the ism and DEMATEL methods the results are somewhat consistent. Integrated ism DEMATEL results for e-waste management constraints determine not only the structure but also the structure of the interactions between these barriers [16]. Accordingly, the preliminary drawback cluster one became about topics including the comparative weights of selection makers in the DEMATEL approach who did now not well bear in mind linking to the team decision-making. Obviously, in a group decision-making hassle, regular decision-makers can always trust their factor of view and count on it to be prevalent via other selection-makers. This way the very last evaluation guides must be close to their judgments, and if the very last assessment effects are near their critiques, the choice maker is willing to simply accept it; otherwise, they may deny it. It is believed that a significant purpose for the aforementioned discrepancies lies in methods based on unstructured comparisons such as DEMATEL [17]. DEMATEL is widely accepted for analyzing the overall relationship between factors and classifying factors into cause-and-effect types. Therefore, this article considers each source as a criterion in decision-making. Based on DEMATEL, the significance and level of significance of each piece of evidence can deal with a mixture DEMATEL method with the source theory for better conclusions. In this article, instead of the comparative criteria provided by the experts in DEMATEL [18]. The corresponding propositions between the bodies of sources are changed. The DEMATEL technique was used as well as creating causal relationships between criteria for evaluating the integrated multiple-scale decision-making (MCDM) outreach personnel program. Integrates DEMATEL and a new cluster-weighted system in which the debate system is a company the reason for the complexity between the criteria is to visualize the structure of relationships it is also used to measure the influence of criteria. Buyukozkan and ozturk can integrate any and DEMATEL innovation in terms of technology and have developed an approach, which is for companies to help determine important six sigma projects and logistics specifically prioritize these projects helps to identify companies [19].

3. RESULT AND DISCUSSION

TABLE 1. Microelectromechanical systems

	Electrical	Magnetic	Mechanical	Thermal	Chemical	Sum
Electrical	0	2	4	2	3	11
Magnetic	3	0	2	1	2	8
Mechanical	2	4	0	1	2	9
Thermal	1	1	2	0	2	6
Chemical	2	2	1	2	0	7

Table 1 shows that Electrical, Magnetic, Mechanical, Thermal, Chemical All values in this table

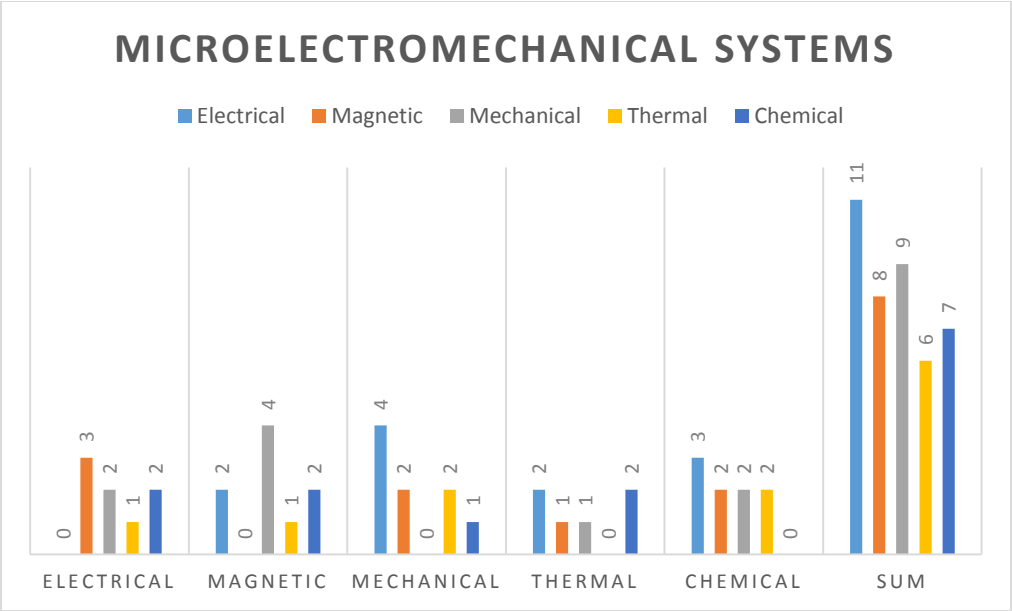

FIGURE 1. Microelectromechanical systems

Figure 1 shows that DEMATEL Electrical it is seen that Magnetic is showing the highest value for Electrical is showing the lowest value. Magnetic it is seen that Mechanical is showing the highest value for Magnetic is showing the lowest value. Mechanical it is seen that Electrical is showing the highest value for Mechanical is showing the lowest value. Thermal it is seen that Chemical is showing the highest value for Thermal is showing the lowest value. Chemical it is seen that Electrical is showing the highest value for Chemical is showing the lowest value.

TABLE 2. Normalization of direct relation matrix

Normalization of direct relation matrix					
	Electrical	**Magnetic**	**Mechanical**	**Thermal**	**Chemical**
Electrical	0	0.181818182	0.36363636	0.181818182	0.272727273
Magnetic	0.272727273	0	0.18181818	0.090909091	0.181818182
Mechanical	0.181818182	0.363636364	0	0.090909091	0.181818182
Thermal	0.090909091	0.090909091	0.18181818	0	0.181818182
Chemical	0.181818182	0.181818182	0.09090909	0.181818182	0

Table 2 shows that the Normalizing of the direct relation matrix in Electrical, Magnetic, Mechanical, Thermal, Chemical of all the data set is zero.

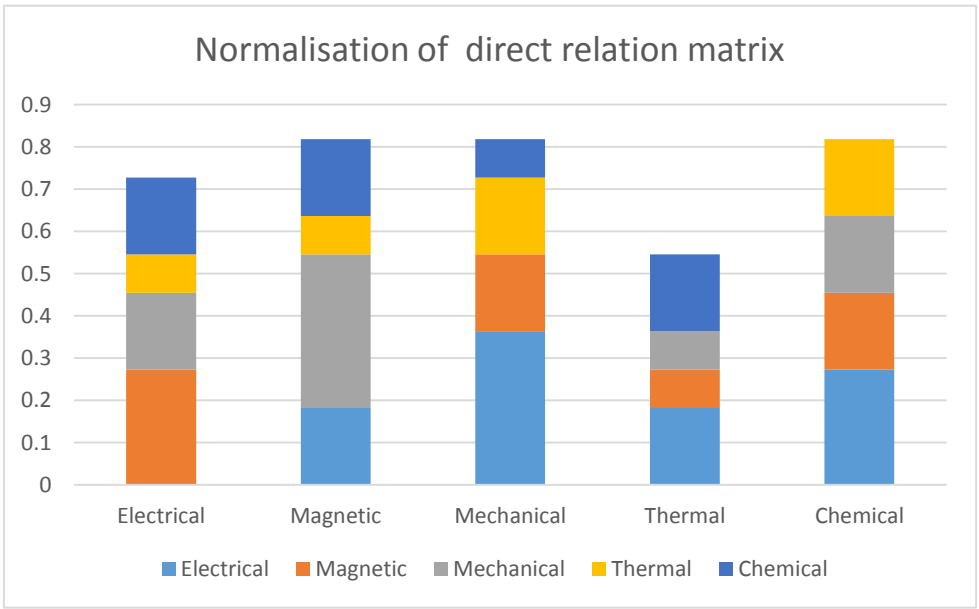

TABLE 2. Normalization of direct relation matrix

Figure 2 shows the Electrical, Magnetic, Mechanical, Thermal, Chemical.

TABLE 3. Calculate the Total Relation Matrix

Calculate the total relation matrix					
	Electrical	**Magnetic**	**Mechanical**	**Thermal**	**Chemical**
Electrical	0	0.181818182	0.363636364	0.181818182	0.27272727
Magnetic	0.272727273	0	0.181818182	0.090909091	0.18181818
Mechanical	0.181818182	0.363636364	0	0.090909091	0.18181818
Thermal	0.090909091	0.090909091	0.181818182	0	0.18181818
Chemical	0.181818182	0.181818182	0.090909091	0.181818182	0

Table 3 shows the Electrical, Magnetic, Mechanical, Thermal, Chemical Calculate the Total Relation Matrix.

TABLE 4. T= Y(I-Y)-1 I= Identity matrix

I				
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

Table 4 Shows the T= Y(I-Y)-1, I= Identity matrix in Electrical, Magnetic, Mechanical, Thermal, Chemical is the common Value.

TABLE 5. Y Value

Y				
0	0.181818	0.363636	0.181818	0.272727
0.272727	0	0.181818	0.090909	0.181818
0.181818	0.363636	0	0.090909	0.181818
0.090909	0.090909	0.181818	0	0.181818
0.181818	0.181818	0.090909	0.181818	0

Table 5 Shows the Y Value in Electrical, Magnetic, Mechanical, Thermal, Chemical is Calculate the total relation matrix Value and Y Value is the same value.

TABLE 6. I-Y Value

I-Y				
1	-0.18182	-0.36364	-0.18182	-0.27273
-0.27273	1	-0.18182	-0.09091	-0.18182
-0.18182	-0.36364	1	-0.09091	-0.18182
-0.09091	-0.09091	-0.18182	1	-0.18182
-0.18182	-0.18182	-0.09091	-0.18182	1

Table 6 Shows the I-Y Value in Electrical, Magnetic, Mechanical, Thermal, Chemical table 4 T= Y(I-Y)-1, I= Identity matrix and table 5 Y Value Subtraction Value.

TABLE 7. (I-Y)-1 Value

(I-Y)-1				
1.616736402	0.848954	0.933891	0.615481	0.876987
0.710460251	1.543096	0.683682	0.455509	0.68145
0.69539749	0.869038	1.56318	0.478243	0.718828
0.441004184	0.484937	0.528033	1.269596	0.535286
0.566527197	0.602092	0.532218	0.469038	1.446025

Table 7 shows the (I-Y)-1Value in Electrical, Magnetic, Mechanical, Thermal, Chemical Table 6 shows the Minvers shows used.

TABLE 8. Total Relation matrix (T)

	Total Relation matrix (T)					Ri
	0.616736402	0.848954	0.933891	0.615481	0.876987	**3.89205**
	0.710460251	0.543096	0.683682	0.455509	0.68145	**3.074198**
	0.69539749	0.869038	0.56318	0.478243	0.718828	**3.324686**
	0.441004184	0.484937	0.528033	0.269596	0.535286	**2.258856**
	0.566527197	0.602092	0.532218	0.469038	0.446025	**2.6159**
Ci	**3.030125523**	**3.348117**	**3.241004**	**2.287866**	**3.258577**	

TABLE 9. Ri & Ci

	Ri	**Ci**
Electrical	3.89205	3.030126
Magnetic	3.074198	3.348117
Mechanical	3.324686	3.241004
Thermal	2.258856	2.287866
Chemical	2.6159	3.258577

Table 9 shows the Electrical Ri 3.89205 Ci 3.030126, Magnetic Ri 3.074198 Ci 3.348117, Mechanical Ri 3.324686 Ci 3.241004, Thermal Ri 2.258856 Ci 2.287866, Chemical Ri 2.6159, Ci 3.258577.

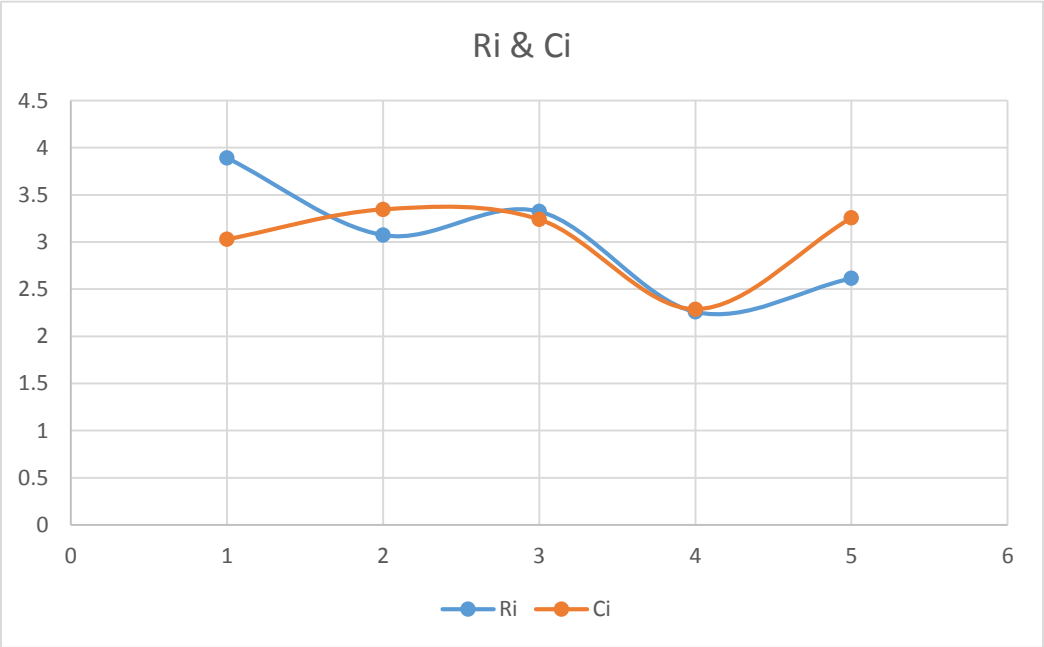

FIGURE 3. Ri & Ci

Figure 3. Ri & Ci Shows the Electrical Ri 3.89205 CI 3.030126, Magnetic Ri 3.074198 CI 3.348117, Mechanical Ri 3.324686 CI 3.241004, Thermal Ri 2.258856 CI 62,2856 Ri862,2856

TABLE 10. Calculation of Ri+Ci and Ri-Ci To Get The Cause And Effect

	Ri+Ci	**Ri-Ci**	**Rank**	**Identity**
Electrical	6.922176	0.861925	1	cause
Magnetic	6.422315	-0.27392	3	effect
Mechanical	6.56569	0.083682	2	cause
Thermal	4.546722	-0.02901	5	effect
Chemical	5.874477	-0.64268	4	effect

Table 10 shows the Calculation of Ri+Ci and Ri-Ci to Get the Cause and Effect. the final result of this paper the Electrical is in 1st rank cause, Magnetic is in 3rd rank effect, Mechanical is in 2nd rank cause, Thermal is in 5rd rank effect and Chemical is in 4rd rank cause. The final result is done by using the DEMATEL method.

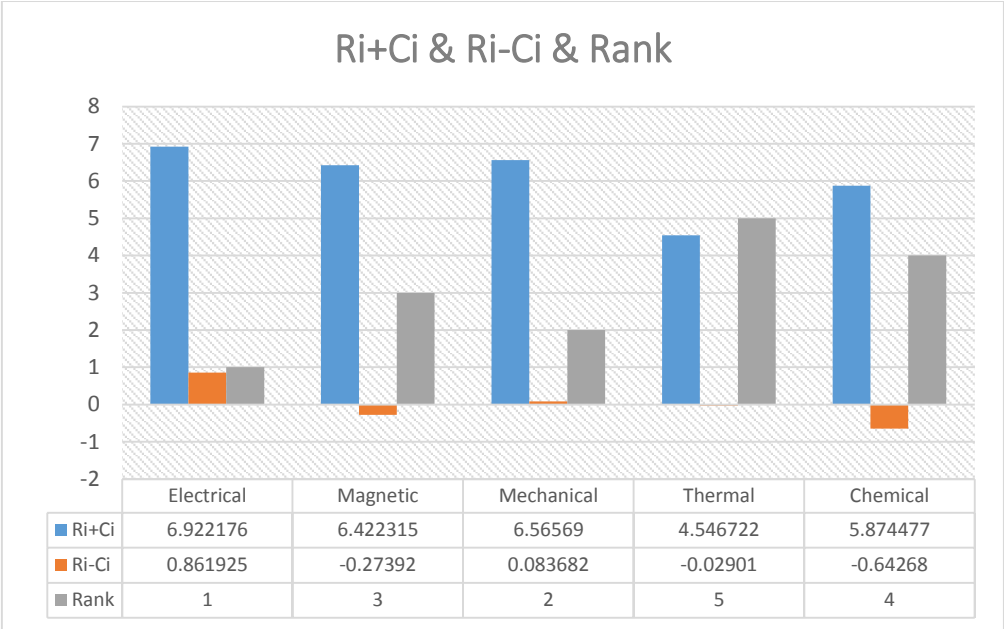

FIGURE 4. Ri+Ci & Ri-Ci & Rank

Figure 5 shows the Calculation of Ri+Ci and Ri-Ci to get cause and effect. The final result of this paper is Electrical 1st rank effect, Magnetic 3rd rank effect, Mechanical 2nd rank effect, Thermal 5th rank effect and Chemical 4th rank effect. The final result is done using DEMATEL method.

TABLE 11. T matrix

T matrix				
0.616736	**0.848954**	**0.933891**	**0.615481**	**0.876987**
0.71046	0.543096	**0.683682**	0.455509	0.68145
0.695397	**0.869038**	0.56318	0.478243	**0.718828**
0.441004	0.484937	0.528033	0.269596	0.535286
0.566527	0.602092	0.532218	0.469038	0.446025

Table 11. Shows T matrix calculate the average of the matrix and its threshold value (alpha) Alpha 0.606627615 If the T matrix value is greater than threshold value then bold it

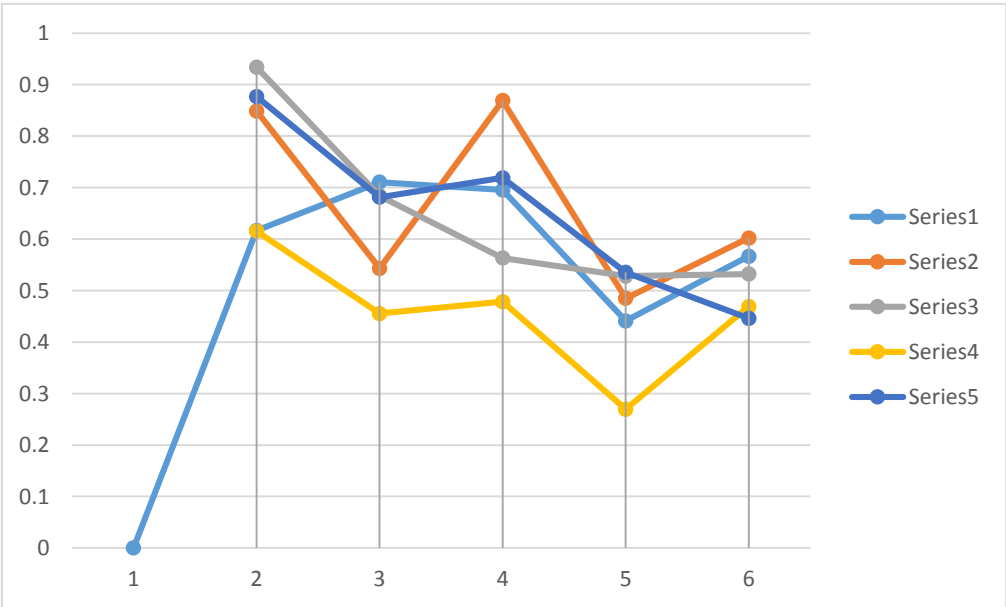

FIGURE 5. T matrix

4. CONCLUSION

Mems over the past several decade researchers' and developers' temperature, pressure, inertia forces, chemical species, magnetic fields, radiation, etc all possible sensitivities a very large number of methods have demonstrated micro sensors. Notably, these many micro machine sensors have their macroscale counterpart's greater efficiency than has been revealed. That is, the micro machined version, for example, of a pressure transducer, generally a very accurate macroscale level mechanism developed using techniques that works better than a pressure sensor. The performance of mems devices is not only exceptional but their production system is integrated and used in the electrical industry same batch fabrication techniques use this is for a device with low production costs and that can translate into many benefits. Consequently, the star device in addition to achieving efficiency, and so at a relatively low cost can do. Silicon-based unique micro sensors were quickly used commercially, and markets for these devices continued at a rapid rate no wonder growing up. More recently, mems research and the development community are many micro actuators have proven. Gas and liquid flow micro valves for control to redirect the light rays or adaptive optical switches and glasses; for displays individually controlled micro mirror arrays, for various applications micro resonators, positive to create fluid pressures micro pumps, in airfoils micro flaps to modify airstreams and so on. Surprisingly, these micro actuators are very small, they are frequent effects at the macroscale level that can cause; that is, this small actuator size a much larger machine than able to perform feats. For example, the researcher's small micro-actuators of the airfoils of an aircraft keep the leading edge and these microminiaturizes made devices only was able to operate the aircraft using this is miniaturized sensors, actuators, and all structures are integrated with electrical circuits (i.e. Microelectronics) is common when bonded to a silicon substrate to realize the true potential of mems begins. Integrated circuit (ic) using process arrays (eg, CMOS, bipolar or (picmos processes) although electronics were invented, micromechanical components adaptive "micromachining" using processes are fabricated, they are silicon select some parts of the scales or new structural layers add. Mechanical and electro-manufacture of mechanical devices. Mems with microelectronics besides, photonics, nano along with other technologies such as technology it's more if you can connect interesting. It is sometimes called "differential integration". These technologies are numerous business markets are filled with opportunities. More complex integration levels are the future of mems technology although trendy, the current sophisticated is very simple and usually a separate micro sensor, a separate micro actuator, with electronics an integrated micro includes sensors. Integrated with electronics the same micro proliferation of sensors, a micro integrated with electronics on an integrated basis with the actuator or electronics of homogeneous micro actuators proliferation. Nevertheless, mems fabrication as the methods progress so does the promise of great design freedom, any kind of micro sensor in it and any kind of micro actuator and microelectronics and photonics, nanotechnology, etc. With the same substrate can connect.

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