



DESIGN AND EVALUATION OF A MICROSENSOR FOR A BIONIC HAND WITH METAMATERIALS- A REVIEW

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Abstract: Prosthetics are the electro-mechanical frameworks which are an incredible assistance in helping the physical difficulties experienced by amputees. These are impelled in various ways, for example, wired associations, pneumatic systems, mechanical systems and shape memory alloys. Mechanical and Pneumatic frameworks that are at present utilized in prosthetics needs exactness, scholarly control and are not exceptionally light in weight. Transducers can be used in which the recognizing components have less weight with closed loop feedback system and precision of the prosthetics can be extended when differentiated with mechanical and pneumatic systems. The demonstration of the bionics can be expanded with the utilization of adaptable sensors in the form of strips and wires. With the utilization of transducers, the conceivable number of degrees of opportunity can be acquired precisely. The detecting factor, constancy in get-together data from sensory system are significant qualities for controlling the prosthetics. Various materials can be used to adjust the dynamic characteristics of transducers and with the utilization of metamaterials in transducers, the resolution can be expanded. The affectability can likewise be expanded with the decrease of structure of the transducer from full scale to small scale level. Shape memory compounds are the activation innovation identified with change of the nuclear structure. These composites can be used in the form of muscle actuators with the end goal that it chips away at the premise of constriction and extension of the prosthetics. The constraints of these detecting components are because of its usefulness in various conditions.

Keywords: Prosthetics, metamaterials, shape memory alloys.

1. INTRODUCTION

A sensor is a gadget which detects the environment and gives the data. There are various sorts of sensors accessible and utilized in different applications. The terms sensor and transducer have regularly been utilized as equivalent words. The American National Standards Institute characterizes a transducer as a gadget which gives a usable yield because of a particular measurand. In 1975, the ANSI standard expressed that transducer was liked to sensor. A transducer is additionally one kind of sensor in which it changes over one type of sign into another type of sign. All transducers go about as sensor yet all sensors can't go about as transducers. Material sensors, pressure sensors, temperature sensors, synthetic sensors, bio-sensors are instances of sensors. Current sensor advancement is drifting toward expanded specialized multifaceted nature in sensor frameworks. As noted above, developing specialized unpredictability requires flexibility in the way to deal with materials R&D. This perception is especially appropriate to the improvement of progressively perplexing and complex sensor frameworks, for example, shrewd sensors that join devoted, on-chip signal handling. The board agrees with the perception that the material science, innovation, and numerical parts of keen sensor frameworks are interlaced to the point that "there is a requirement for a very much centred, all around coordinated, concentrated research program to devise generally pertinent, precise, and moderately reasonable savvy sensor frameworks" (UNIDO, 1989). This strengthens the requirement for an interdisciplinary system for recognizing needs and creating sensor innovations. In this way, the materials network must have the option to function as full accomplices inside the multidisciplinary group [1].

Sensors are broadly utilized in a wide range of uses, and sensor innovation has become an essential empowering innovation in numerous cases. The fast increment in the enthusiasm for sensors has been driven by various applications, for example, smart assembling handling, in which sensors can give an enormous advantage. What's more, sensors are critical in security related zones, with applications going from evaluating the trustworthiness of airplane to observing the earth for perilous synthetic compounds [1].

Chosen instances of sensor applications and kinds of sensors were picked to delineate the distinctive main impetuses and contemplations examined above: innovation push, business advertise pull, military applications, lifecycle the executives, and administrative requests. These outlines are not expected to be far reaching. Or maybe, they are pertinent models from which the council distinguished general ends concerning research needs in sensor materials and the fast advancement of sensor innovations for high-result applications. Every model portrays an application, talks about the key specialized issues relating to the utilization of sensors, and recognizes key sensor material needs. Every sensor-type model depicts the physical marvels being detected, a scientific classification of the distinctive sensor types, and sensor

materials issues identified with the application. Of need, these cases are disentanglements of the real world. For example, sensor needs are presented as though every sensor were a free element, in spite of the fact that in all actuality numerous applications require varieties of sensors or combination of data got from a wide range of sorts of sensors [1].

New sorts of sensors are made conceivable with new materials that are created utilizing propelled preparing advances. To a more noteworthy degree than this innovation push, showcase pull is driving expanded action in sensors. The essential market needs can be sorted as financial, administrative, and extraordinary government necessities. Monetary inspirations for improved sensor materials and innovation incorporate decreasing the expense of item fabricate, expanding an item's usefulness at low extra expense, and improving the nature of the item. These inspirations likewise improve item seriousness. For instance, the quality, security, and solace of cars have been significantly improved by the numerous sensors joined into the activity of current vehicles (Shepard, 1992). Thus, the expense of assembling and the recurrence of imperfections in vehicles have been significantly decreased by the expanded utilization of sensors during make. A similarly significant financial driver is the improvement and fuse of sensors into items that guide in broadening usable life. Models incorporate sensors for motor oil that screen the honesty of engine oil in a motor, permitting a client to replace oil just when it is important because of ointment corruption, and sensors that can recognize erosion or metal weariness in more seasoned airplanes in lieu of progressively costly remotely applied investigation methodology [1].

Sensors have been fundamental in fulfilling a bounty of government-ordered administrative necessities which incorporate such applications as estimating compound emanating from industrial facilities and fumes gases from autos. These sensors can likewise have critical monetary effect and impact on the personal satisfaction. Government offices have numerous one of a kind, wide-running sensor needs. The military has been on the main edge of applying sensor advancements to improve its operational capacity. For example, as a result of broad media inclusion, the overall population is presently very much aware of "keen" weapons utilized during the ongoing Persian Gulf strife. Sensors were utilized to create important data about the objective, and once the weapons were propelled, they were guided to the objective progressively by different sorts of on-board sensors. An extremely requesting requirement for new sensors is spoken to by National Aeronautics and Space Administration's Earth Orbiting Satellite program, which has the objective of checking changes in synthetic organization and temperature of the world's environment (Zorpette, 1993). Right now, materials and advances will be required to give sensors that have the required affectability in the phantom locales of significance. The decrease in the size of the military powers and the subsequent shutting of army installations have prompted a prerequisite for sensors fit for checking the tidy up and removal of various poisonous natural mixes, synthetic fighting operators, and out of date weapons. Sensors will be required for on-line control to produce low-volume claim to fame parts or ultra-elite military airplane. Without sensor-based control for these particular needs, the expense per unit would probably be restrictive. In light of the assorted variety of sensor advancements and applications and the subsequent decent variety of materials requirements for sensors, it is as often as possible conceivable to fulfil a given need with more than one sort of sensor. A key finding of this board of trustees is that a "perfect" sensor material doesn't exist separated from the setting of a particular application. This reality significantly affects arranging R&D of sensor materials and frameworks. To quicken sensor improvement, a R&D technique that keeps up an expansive applications-driven research base is vital. This requires the recognizable proof and backing of basic centre abilities. The different idea of sensor innovation improvement requires an interdisciplinary culture. It further requires an application centre around chosen sensor advancements and materials. Hazard, logical and mechanical effect, and headway of an information base for sensors must be considered so as to recognize the most encouraging open-door territories that can have a significant effect and lead to an enormous quantifiable profit [1].

General Sensor Issues

A key issue brought up in past reports of the National Materials Advisory Board (as referenced in the Preface) is that sensors are the powerless connection in canny handling. There are central worries about the capacity of other accessible sensors to act in an uproarious or unfavourable assembling condition, exacerbated by genuine imperatives that include:

- Short time constants: detecting extremely fast, restricted changes or enormous inclinations in a material more than a few hours of preparing;
- Chemical change checking: detecting the nonlinear conduct of at least one concurrent compound responses and related side-effects;
- Point estimation: detecting basic focuses, rates, and changes in rates inside a mind-boggling three-dimensional product shape.
- Inferred estimation: detecting parameters of intrigue that are not straightforwardly quantifiable. Astute preparing of polymeric grid composites offers an away from of the difficulties presented by these issues and advantages that could result from propels in sensor materials and innovation [1].

Prosthetic contraptions for upper limbs evacuation have been investigated for a significant period of time. Starting at now, some prosthetic hands are used by amputees; while another course of action of something different complex contraptions is being under investigation planning to give better presentations. The past, clinical prosthesis, are respectably direct devices which design has been principally arranged to outfit amputees with some basic functionalities for understanding and performing fundamental control. The latter, or of course skilful hands, are not as yet being utilized for clinical use because of the nonattendance of acceptable interfaces with the customer [2].

At present, prosthetic hands not have numerous degrees of opportunity. In an enormous part of them, the control by the customer is performed through myoelectric signals. The customer headings are conveyed enthusiastically subject to the action they wish to do and the visual information they see from the working zone. Shockingly, such prostheses don't give contribution of the joint effort powers, or other kind of information from proprioceptive or exteroceptive sensors, to the customer. This nonattendance of sensations doesn't help with working gainfully with these robotized devices. Other than the unavailability of better observing the task, the customer can't contribute profitably enough to the unending control of understanding or other strong exercises. The customer just understandings a muscle, or its foe, to give the relating demand [2].

Human hands, which have been become so far for current and prosthetic purposes can be commonly arranged as significantly able hands with various actuators and unimportantly instigated hands. The past social affair has various actuators, set on the lower arm or then again

in the hand itself, by scarifying the weight and the size of the hand and also the enactment power. These hands can understand and control a wide extent of things by applying a multifaceted control framework. In any case, due to their electromechanical and control designing unconventionality, they are not the best option for various applications that demand straightforwardness, delicate quality and simplicity. Here, we call the last assembling as the inconsequential enacted hands, implying bionic hands that contain one to six actuators (stood out from the 34 muscles of a human hand). These hands can be totally induced or under-actuated. In the two cases, their focal points over the past social affair include:

- Simpler electromechanical structure
- Lower weight, size and cost
- Simpler control plan [3].

2. LITERATURE REVIEW

Kaushal Gangwar and et.al in their paper titled “Metamaterials Characteristics, Process and Applications” concluded that the metamaterial is accepted to have an impact across the entire range of technologies where electromagnetic radiation is used will provide a flexible platform for technological advancement. It is a negative refractive index material have drawn special interest in microwaves. The properties that which will allow for the decrease in size as compared to that of the other materials for the multiband operation and reconfigurability of microwave devices and antennas. The most attractive application is an absorber, and as a sensor for humidity, soil moisture measurement. It is also known that no advancement in metamaterials research will be not possible without any further development in the fabrication. The growth and significance in this field is clear that the future of metamaterial lies in the field of optics and medical. It is closely linked to development of nanotechnology [4].

Shridhar E. Mendhe and et.al in his paper titled “Metamaterial Properties and Applications” in his paper, a short survey of history of metamaterials, some of quiet highlights and thoughts for metamaterial, different sorts of metamaterials, different utilizations of metamaterials have been examined. Electromagnetic reaction works that can offer energizing potential outcomes of future structure of gadgets and segments are assessed. Some quiet properties of metamaterial have been surveyed [5].

Gurwinder Singh and et.al in his paper titled “A Review of Metamaterials and its Applications” concluded that metamaterials are the new field of research, most assuredly it turns into an incredibly energizing examination territory. The analysts from numerous orders are being pulled in towards metamaterials due to its remarkable electromagnetic properties. Right now, short survey of the historical backdrop of metamaterials, some of notable highlights, different sorts, applications and distinctive displaying techniques for metamaterials have been examined. The metamaterials have brought about astounding upgrades in electromagnetic reaction works that can offer energizing conceivable outcomes of future structure of gadgets, segments and notable properties of metamaterials [6].

Manish Kumar and et.al in his paper titled “Analysis of Metamaterials –for its Different Properties and Areas of Applications” concluded that, the exploration work introduced right now the ongoing improvements and utilizations of metamaterials in various fields. This paper has likewise featured the capability of metamaterial innovation to abuse the future research headings through down to earth usage. We expect that numerous other entrancing revelations and application will be found in future and investigate the shrouded universe of metamaterials [7].

Subimal Deb and et.al in his paper titled “Absorption and dispersion in metamaterials: Feasibility of device applications” concluded that he had considered three potential gadget utilizations of MMs thinking about their assimilation and scattering in the structure of a full causal reaction. We demonstrated how in current acknowledge of MMs, the misfortunes wash out the intriguing transmission and postpone includes in RT. Impeccable imaging capacities of current day detached metamaterials are additionally constrained because of their natural misfortunes. Retention pay by presenting gain was investigated as a potential course to defeat these confinements. The plausibility of accomplishing huge transmission delays was additionally appeared. Retention remuneration end up being helpful with regards to consummate imaging too. Presentation of addition in the attractive reaction is appeared as a potential course to acknowledge such gadgets. At last, solid iota pit connection in a doped FP cavity with MM mirrors was concentrated to show the ordinary mode parting [8].

Ya-Fen Ge and et.al in his paper titled “A Comparison of Active and Passive Metamaterials from Equivalent Lumped Elements Modes” concluded that The EM material parameters conditions for general dynamic and uninvolved metamaterial are determined and thought about from proportional lumped components modes. In the correlation investigation of adjusted and unequal lossless ($R = G = 0$), latent lossy ($R > 0$,) and dynamic lossy ($R < 0$,) cases, various misfortunes impacts (from the progressions of opposition right now) a few consequences for stage consistent and the genuine piece of trademark impedance, just as a major effect on lessening steady and the fanciful piece of trademark impedance. One can utilize included dynamic component to metamaterial to improve the weakening qualities and afterward to defeat the significant downside of misfortunes impacts in metamaterials [9].

Shuang Chen and et.al in his paper titled “A Review of Tuneable Acoustic Metamaterials” concluded that the controlling acoustic waves with metamaterials as well as metasurfaces is useful in acknowledging subwavelength acoustic gadgets and frameworks. Notwithstanding, the thin working band of the vast majority of the created metamaterials because of the nearby resounding nature of acoustic metamaterials may restrict their functional application. Right now, give a study of the as of late created tuneable acoustic metamaterials dependent on different balance systems, incorporating acoustic metamaterials with piezoelectric materials, precisely controllable segments, and with electric and attractive biasing. Such dynamic AMMs are promising competitors in numerous applications, including the weakening of acoustic waves, imperceptibility shrouding, and acoustic wave front building, for example, centering. It is significant that escalated endeavours on tuneable AMMs have been proposed to effectively adjust sound transmission/reflection in sonic, infrasonic, and ultrasonic fields. These investigations are just centered around hypothetical and numerical displaying, just as test show; there is as yet far to go in the common sense utilization of AAMMs [10].

Miss. Varsha Chavan and et.al in his paper titled “A Review on Bandwidth Improvement using Metamaterial” concluded that this survey paper shows systems and techniques for improving the data transfer capacity of MPA utilizing metamaterial. Metamaterials will be Metamaterials is another term portraying an idea of fake, man-made materials made out of little cells containing at any rate two distinctive characteristic materials. Metamaterials can display considerably more articulated electromagnetic properties than characteristic materials so they can be utilized in the new fast broadband frameworks. Anyway, ongoing investigations and trial found that adjustment of state of split ring resonator, by utilizing cluster of resonators with slight wire. additionally, by stacking of fix reception apparatuses, by presenting split ring resonator at the ground plane [11].

Jiangyi Zhang and et.al in his paper titled “Dark Solitons in Acoustic Transmission Line Metamaterials” concluded that he had hypothetically and numerically considered envelope dull (dark and dim) solitons in 1D nonlinear acoustic metamaterial made out of a waveguide with an intermittent exhibit of side openings, highlighting viscos warm and radiation misfortunes. In view of the electro-acoustic similarity and transmission line approach, we determined a nonlinear grid model. We examined the straight scattering connection of our framework, which was seen as in great concurrence with the one got by utilizing the exchange network strategy. We utilized a numerous scale annoyance technique to diagnostically treat the issue, and inferred a compelling NLS model depicting the advancement of the weight. We anticipated the presence of dull solitons and concentrated systematically their development within the sight of misfortunes. We researched the interaction between scattering, nonlinearity and scattering, as depicted by relevant trademark length scales, on account of a water-filled acoustic metamaterial with a little sweep of side gaps. The numerical outcomes were seen as in great concurrence with the explanatory expectations. Our outcomes and approach prepare for considers on nonlinear marvels in twofold negative acoustic metamaterials, model wave directs intermittently stacked with side gaps and clipped versatile plates. Our works will likewise help in structuring new nonlinear acoustic metamaterials supporting splendid, hole, dark and dim solitons. As per the properties of the solitons, i.e., engendering with no twisting of high plentifulness waves, our investigations could likewise make ready to planning new gadgets in therapeutic applications or to structuring non-damaging sensors [12].

Jiawen Xu and et.al in his paper titled “Broadening Bandgap Width of Piezoelectric Metamaterial by Introducing Cavity” concluded that right now, metamaterial comprising of piezoelectric transducers coordinated to have substrate with inductive circuits was contemplated. A lumped-parameter, semi-explanatory model of piezoelectric metamaterial was figured dependent on continuum mechanics portrayal. The identical unit-cell mass, solidness, and electro-mechanical coupling parameter were inferred, which were wavenumber-subordinate. The job of the framework level electro-mechanical coupling was identified and broke down in detail. While the recurrence scope of the bandgap is controlled by the LC circuit resounding recurrence, the transmission capacity of the bandgap is principally dictated by the electro-mechanical coupling. At that point, a technique for data transfer capacity expanding through joining depression in the substrate of the unit-cell was displayed. On a very basic level, the pit presented could build the framework level electro-mechanical coupling, accordingly benefiting the bandgap conduct. It was shown that the bandgap width of the piezoelectric metamaterial could be extended from 45 Hz to 126.7 Hz. The expository definition and cavity amalgamation can be utilized to control the structure advancement of the piezoelectric metamaterial [13].

Morteza Karami and et.al in his paper titled “Polarization-independent negative index metamaterial” concluded that another polarization-heartless left-gave metamaterial is exhibited dependent on S-formed resonators. Numerical outcomes exhibit polarization properties and compelling refractive records. These structures can be manufactured for microwave use utilizing 3D printing strategies and exploratory outcomes will be introduced [14].

Neelam Singh and et.al in his paper titled “A Review Paper on techniques and design for metamaterial Absorber” concluded that this paper shows the audit and overview of methods and plan for the structuring of Metamaterial Absorber. By utilizing one of any previously mentioned method a portion of the confinements of traditional Metamaterial Absorber attributes is improved. This audit work is done on certain qualities actualized through various systems. By the by, helpful arrangement is still less and experience the ill effects of various issues like intricacy of structure, improved data transmission, decrease of addition and so on. Henceforth, the creator feels that further research and more work is required in these regions [15].

Richard W. Ziolkowski and et.al in his paper titled “Metamaterials based Antennas: Research and Developments” that the metamaterials explore region has advanced into conspicuousness without a doubt, as of late. Regardless, it is now largy affecting the universal electromagnetics network. Metamaterials have rejuvenated our inclinations in complex media; their fascinating properties; their examination and numerical demonstrating and their potential applications. There have been enormous walks in our comprehension of their odd practices and of their conceivable usage in numerous electromagnetic applications from the microwave to the optical system. This survey has just briefly addressed some particular research efforts related with metamaterials and their receiving wire applications. Metamaterials, due to their guarantee to give engineerable permittivity's and permeabilities, have fascinating properties for the plan of cutting-edge structures for emanating and dispersing applications. Artificial attractive conductors have been accomplished with high impedance and recurrence specific surface builds just as with volumetric consideration-based media. Resonances emerging in electrically little locales of room where single and twofold negative materials are matched with basic twofold positive materials were appeared to have an incredible potential for beating the breaking points for the most part connected with a few electromagnetic issues by giving a way to build the general reactions of the frameworks. Zero-list metamaterials, media with permittivity and permeabilities with zero or approach zero qualities, may have solid effect in certain applications regardless of their non full character, since they join strange wave connections with generally bigger transfer speed and lower misfortunes. Metamaterials have been considered as a way to control the size, efficiency, transfer speed, and directivity of a few essential transmitting and dissipating frameworks. There are numerous specialists whose works were not referenced, and I am sorry to every one of them. Metamaterials and their receiving wire applications is an extremely rich research territory wherein there is a lot of premium. The underlying seed material science efforts are just presently starting to hold up under some building applications natural product. There stay many testing and conceivably remunerating issues left to settle; we as a whole anticipate sharing these arrangements sooner rather than later [16].

Milan Secujski and et.al in his paper titled “A Novel Approach to Density Near-Zero Acoustic Metamaterials” concluded that his paper proposes a novel way to deal with accomplishing thickness close to zero spread of acoustic waves. A full unit cell recently utilized for acquiring a twofold negative metamaterial is utilized to accomplish spread of acoustic waves with for all intents and purposes no adjustment in stage over genuinely long separations. Right now, acoustic vitality doesn't spread but instead burrows through a NZ metamaterial. Having as a main priority the wide scope of use of NZ metamaterial structures, including vitality burrowing, vitality parting, and ideal transmission through waveguides with sharp twists just as different kinds of wave front control, this exploration without a doubt offers a significant commitment right now. Our future work will incorporate the manufacture of the proposed unit cell and test check of thickness close to zero engendering, just as examination of progressively complex structures dependent on the showed wonder [17].

Ahmed Mahmood and et.al in his paper titled “Design and Fabrication of a Novel Wideband DNG Metamaterial with the Absorber Application in Microwave X-Band” that right now, adjusted S-shape ring resonator in intermittent game plan is presented and explored both numerically and tentatively. In view of the trial results acquired, it has been shown that the proposed structure displays wide band DNG qualities in the recurrence band of intrigue. At the end of the day, the tested novel metamaterial is very much structured and effectively works around the reverberation recurrence to give at the same time twofold negative permittivity and penetrability in X-band. Also, straightforward manufacture of this novel metamaterial is another structure advantage. A safeguard application has additionally been considered and estimated. The estimation results show great concurrence with the recreation results. Furthermore, the re-enacted outcomes for S-parameters and the assimilation rate are gotten at various polarization edges. It has been demonstrated that high retention can be accomplished for angled rates up to 40° and with ingestion top over 90% somewhere in the range of 8.825 and 9GHz. An ideal safeguard can be gotten at the reverberation recurrence around 8.912GHz [18].

Zan Lu and et.al in his paper titled “Design and Analysis of a THz Metamaterial Structure with High Refractive Index at Two Frequencies” concluded that a high-refractive-index metamaterial structure with dual frequency band was designed through simulation and analysis. Results show that the metamaterial, designed with gold structures embedded with polyimide film, effectively exhibits a high refractive index at two frequency bands. In the second frequency band, the high refractive index is of relatively smaller value than the main effective band. It is expected that through modifications in geometry and design, improvement in the electric and magnetic resonant frequency and the refractive index value can be enhanced for the second frequency band. The methodology applied in this study could be applied to structures to design high-refractive-index metamaterials at multifrequency. Since polyimide has good flexibility and isolation property, the designed structure can be used in a variety of applications [19].

Yu Liu and et.al in his paper titled “Fractal Acoustic Metamaterials with Subwavelength and Broadband Sound Insulation” concluded that In this work, we have planned another kind of self-comparable fractal acoustic metamaterial with space-snaking twists and have deliberately examined the subwavelength-scale and broadband sound protection properties of these materials by ascertaining their band structures, effective parameters, transmission misfortunes, and sound weight fields. To begin with, the outcomes show that as the fractal request expands, more bandgaps show up, especially in the GX course and also, there are progressively directional bandgaps and high transmission misfortune tops show up in these bandgaps, in this way demonstrating the proposed structures can accomplish broadband sound protection. Second, with the expanding fractal request, the first bandgap becomes lower, especially in the third request, where the standardized recurrence in the GX heading is 0.063, this is a lot littler than 1, hence demonstrating that the planned structures can accomplish subwavelength-scale sound control. Moreover, the recurrence scopes of the negative effective parameters are all around coordinated with the bandgaps, which is the explanation behind the creation of these bandgaps. These outcomes show that contrasted and the self-comparable fractal structure announced previously, the new planned structure has a more extended effective length and increasingly exceptional properties for broadband and low-recurrence sound protection, and they are promising for applications in designing applications. Later on, work, to make the new planned structure show the best acoustic properties, we will consider the influence of passage width and the structure will be additionally advanced [20].

Yu Guo and et.al in his paper titled “Applications of hyperbolic Metamaterial Substrates” concluded that the most recent decade has seen gigantic improvement in the material science and nanofabrication of different classes of metamaterials. The following decade is set for metamaterial applications in different fields. For gadgets in the obvious and close IR wavelength ranges, hyperbolic metamaterials are relied upon to lead the route because of their differed properties and appropriateness. One significant heading of use will be quantum nanophotonic. We have appeared here the capability of HMMs for nanoimaging, subsurface detecting, Dyakonov plasmonic, fluorescence building, and warm strategic. This paper should assist experimentalists with social occasion a unified perspective on the different uses of hyperbolic metamaterials for structuring gadgets [21].

Jeremaih P. Turpin and et.al in his paper titled “Reconfigurable and tuneable Metamaterials: A review of the theory and applications” concluded that right now, have broadly reported the condition of the metamaterials field as it applies to the age and use of tuneable or reconfigurable electromagnetic reactions. In spite of the fact that metamaterials are themselves in the beginning periods of advancement, we have delineated that the investigation of tuneable metamaterials is a lively and dynamic subfield, in light of the expansiveness and profundity of the applications and strategies that have been accounted for on in the writing. By arranging the tuning instruments and applications into bunches dependent on usefulness and capacity, as opposed to operational recurrence, our principle objective is to give an extensive outline of the cutting edge in tuneable and reconfigurable metamaterials. New tuning strategies and investigation systems might be applied to existing static metamaterial plans to significantly build their capacity and viability. In spite of the fact that there is more advancement that must be made before a considerable lot of the procedures talked about here might be for all intents and purposes applied, quick improvements in tuneable metamaterials hold incredible guarantee for future usage [22].

Ke Chen and et.al in his paper title “Broadband Microwave metamaterial absorber with lumped resistor loading” concluded that an elite meagre thickness, polarization-cold hearted, and broadband microwave metamaterial safeguard stacked with lumped components has been structured, mimicked, and tentatively verified. The working band of the proposed metamaterial safeguard can cover the entire X-and Ku-groups, with generally stable precise execution for occurrence point up to about 60°. The structure guideline of the proposed metamaterial safeguard is reliant on the stacking of lossy materials, which can be conceivably stretched out to other recurrence band or even scaled at a lot of high frequencies, for example, milli-meter wave band and terahertz. Furthermore, our proposition may find potential uses in military applications, for example, electromagnetic similarity, target shrouding, and so forth. This work is halfway bolstered by National Key Research and Development Program of China (Grant No. 2017YFA0700201), the National Nature Science Foundation of China venture

subsidized by China Postdoctoral Science Foundation, and incompletely upheld by Fundamental Research Funds for the Central Universities, PAPD of Jiangsu Higher Education Institutions, and Jiangsu Key Laboratory of Advanced Techniques for controlling electromagnetic waves [23].

Zhao Hong Wang and et.al in his paper titled “Research Progress of acoustic meta surface in china” concluded that a great deal of research on AMS is created, and metasurfaces with different fundamentally shape unit, for example, confounded, space-snaking, winding, rectangular section, round openings with Helmholtz thunderous, and Penta mode structures are inquired about and detailed, however not many have indicated fruitful test manufacture and estimation approval to understand their application practically speaking. The manufacture and estimation system of AMSs are critically out of luck. The acoustic gadgets including acoustic focal point, shroud, and diode by AMSs have potential applications for acoustic correspondence, biomedical test and treatment, seismic tremor insurance, and molecule catching and control. The scaling down and high-incorporation are the most significant creating objectives of different acoustic gadgets, and the slim thickness is basically required for low recurrence sound tuning. In future, the AMS can control low recurrence sound by the ultra-profound subwavelength thickness to tackle those issues, so the low recurrence acoustic wave control inside expansive transfer speed for ultrathin scaled down metasurfaces is most significant application and advancement. What's more, creating propelled enhancement and displaying strategies for metasurfaces, it is conceivable to plan novel and improved metasurface structures with wanted acoustic characteristics [24].

Ya Fan and et.al in his paper titled “Recent Developments of metamaterials or meta-surfaces for RCS reduction” concluded that, he had outlined the RCS decrease advancements dependent on metamaterials and meta-surfaces and investigated their improvements as of late. The audit principally focuses on the structure guideline, stage change control, re-enacted, and exploratory execution. Without upsetting the first EM field appropriations, we have exhibited three sorts of EM shrouds for the objectives of light weight, huge shrouding region, and expansive transmission capacity. By Utilizing the stage changes brought about by fitting the measurements, turning their geometric places of the resonators, and changing over the polarization condition of occurrence waves, metasurfaces structured with stage inclination profiles and arbitrary coding arrangements have been verified to accomplish phenomenal exhibitions for broadband RCS decrease. From the introduced models, we can likewise observe the ground-breaking capacity of stage metasurface to shape the close filed conveyances just as tailor the far-field radiation in microwave system. The paper finally audits the advancements of EMW safeguards improved by metamaterials or metasurfaces, including resistive metamaterials safeguard, attractive microwave safeguard upgraded by PGM, and farce surface polaritons (SSPs) safeguard. With respect to different prerequisites in pragmatic applications, albeit such metamaterials and metasurfaces have given progressively flexible specialized conventions, there are as yet a few issues to explain in future work. One is to additionally scale down the elements of major resonator into as little as or a lot littler than profound sub-wavelength size. These conditions to read new working standard for conquering enormous thickness and mass profile at low microwave frequencies. The last however the most significant one is to examine how to ensure incredible RCS decrease execution of conformal metamaterials or metasurfaces [25].

M.H.Li and et.al in his paper titled “Perfect Metamaterial Absorber with Dual Bands” concluded that the polarization uncaring and wide-point metamaterial safeguard with double groups has been effectively created and tried. For the better comprehend of the physical system of the double band metamaterial safeguard, current dissemination on the metals and the conveyance of intensity misfortune were plotted. Ingestions under various polarizations of occurrence electromagnetic waves are determined with extent of over 97% at low-recurrence top and 99% at high-recurrence top individually. Also, the estimation results with wide occurrence point going from 0° to 60° are given. The retentions stay over 90% at the low-recurrence top and 92% at the high-recurrence top for both transverse electric wave and transverse attractive wave. With geometrical adaptability, this double band metamaterial safeguard could understand at other recurrence extend with about impeccable assimilation. These metamaterials have extraordinary guarantee for future applications, for example, bolometer, EM wave spatial filter, and so on [26].

Mr. Tj Brown and et.al in their paper entitled “A new low-cost bionic hand” concluded that Innovation has made considerable progress in the previous three decades. Electronic gadgets have become less expensive and less expensive consistently in light of new headways that help make littler, quicker, also, increasingly solid gadgets. The later headways in the field of prosthetic appendages have empowered patients to control bionic appendages utilizing electrical signs that are created from muscle compressions through a procedure called electromyography (EMG). In any case, these bionic appendages have not been around long and the expenses related with them are still too high to even think about making them available to the individuals who truly need them. This examination venture uses as of late procured abilities in Electro-Mechanical Engineering Innovation to bring down the cost of a bionic hand. The mechanical parts that make up the hand are structured utilizing 3D CAD programming and afterward made on a 3D-printer. Utilizing 3D-printing, the hand can undoubtedly be scaled to any measure considerably more economically than utilizing customary techniques. The undertaking additionally brings down expense by structuring and making its own EMG circuit. This is the most significant part of the entire framework since it gives the client power over the hand. Without it, the hand is simply for looks. The EMG circuit estimates voltage over an arm muscle. At the point when the muscle contracts, the circuit imparts signs into a microcontroller that works the 3D-printed hand with the assistance of a couple of servos. There are a few organizations at present chipping away at less expensive models of bionic hands too, however a large portion of these have restricted usefulness and the expense to get them is still excessively high. The all-out expense of this bionic hand venture so far is roughly \$500, contrasted with different models on the market today that sell for as much as another vehicle. Without a doubt, this hand isn't prepared to supplant a prosthetic hand at this time, however the constructed model was a finished achievement. The following stage of the venture is to concentrate on plan upgrades and to include another EMC circuit so as to understand more muscles. This will permit the bionic hand to carry some genuine challenge to the market and drive the value down [27].

Aliaksei L. Petsiuk and et.al in their paper entitled “Low cost open source ultrasound sensing based navigational support for visually impaired” concluded and built a sensor for navigation for blind people. The sensor was developed through 3D printing process. The device was built with less than \$24 USD. The range of the sensor was found to be at a distance of 4 m and to an area of 0.5 m^2 . The user must sweep the sensor head along the direction they are moving. It is found that moving speed of the sensor to track the objects was up to 0.5 m/s within one-meter distance. During the development of the sensor, there were several limitations raised i.e., low spatial resolution, less response rate, narrow scanning angle and distance estimation [28].

Haraa Raheem Hatem and et.al in their paper entitled “Design and implementation of ultrasonic radar system for distance measurements using Arduino” designed an ultrasonic sensor using Arduino for measuring distance. They designed sensor using java application with Arduino and servo motors. The sensor should be tested for a range of 500cm with an angle of rotation of 180 degrees. The effectiveness of

the distance can be obtained by statistical analysis of the distance error between radar and obstacles. The sensor is implemented experimentally for measuring distances in different applications. Three types of materials i.e., wood, aluminium and sponge were used in the design as obstacles. The results show that the percentage distance error recorded for wood, sponge and aluminium obstacles do not exceed 2%, 7% and 6% respectively which can be accepted in many applications [29].

Fuxu Li and et.al in their paper entitled “Application of ANSYS APDL in the Design of Piezoelectric Transducer” designed a piezoelectric sensor and analysed it in the ANSYS 15.0 software. The piezoelectric is made of ceramic and metal materials. The ceramic materials considered are SUS304 and PZT-4 with a density of 7930 and 7500 kg/m³ respectively. The simulation values are validated through ANSYS 15.0. the piezoelectric coupling is proved [30].

Qiguo Huang and et.al in their paper entitled “Design and Fabrication of a High-Frequency Single-Directional Planar Underwater Ultrasound Transducer” fabricated and tested a composite piezoelectric transducer using PZT5-A pure piezoelectric ceramics. A high frequency single directional planar underwater transducer was analysed. It is designed and analysed in ANSYS software with three structural models with same size. The resonant frequency for the piezoelectric composites was reduced by adding flexible polymers to it. The epoxy resin 618 was selected as the polymer and filled. The ultrasound underwater sensor was successfully fabricated by using the polymer composites. The transducer was tested in the water and air and it is found that the frequency of the transducer is similar to the 1-3 piezoelectric composite i.e., 151kHz. When the resonant frequency of the transducer is 151 kHz, its transmitting sound source level is as high as 220.1 dB, its transmitting voltage response is as high as 183.8 dB, and its receiving sensitivity is -184.3 dB. The directing angle for the transducer is 2.4° when the beam width is -3dB. The transducer which was developed used to transmit and receive signals for communication under water [31].

Heike Wiedemann in his paper entitled “Analysis of Ultrasonic Sensors Regarding Their Use in Safety Systems in Industrial Environments” analysed the reliability of the ultrasonic sensor to increase the human safety in industrial environment in order to avoid false statements provided by the ultrasonic sensor. The effect of the different fabrics on the measurements of ultrasonic sensors is analysed. He determined the effects of the cloth in the measurement of the sensor by testing different fabrics. He placed a cardboard in a room and there are no objects near in the room. The cardboard which is placed is taken as reference point and measured the distances from a fixed point by using ultrasonic sensor. He then wrapped the box with different fabrics and the distances are measured. This was repeated at 10 times with different fabrics materials and thicknesses are used. The sensor used by him was SRF05 sonar sensor. It is a 40kHz ultrasonic sensor which acts as both transmitter and receiver. The measurements were noted as per the fabrics used [32].

Kiran kumar B. Balavalad and et.al in their paper entitled “Design and Simulation of MEMS Capacitive Pressure Sensor Array for Wide Range Pressure Measurement” designed MEMS capacitive sensor array simulated in the COMSOL and MATLAB Simulink software's. Each sensor having diaphragm side length of 60µm and a depth of 3µm. The diaphragm thicknesses are varied in the order of 1.5µm, 2µm, 2.5µm, 3µm. The linearity of each pressure sensor in the array have been studied and the output is read out by using combinational switching mechanism available in COSMOL and MATLAB Simulink. The work done is possible to measure pressure over a range of about 0-33.25MPa. The pressure can be varied by varying the diaphragm thickness of the sensor [33].

Jinkai Xu and et.al in their paper entitled “Design and finite element simulation of an ultrasonic transducer of two piezoelectric discs” designed and simulated a piezoelectric transducer based on longitudinal vibration which can be used for precision machining, medical and other fields. In this they made the front cover of the transducer as a horn which amplifies the output amplitude. They used ANSYS 15.0 to analyse the transducer model. They also used Hyper Mesh software in order to ensure the quality of the mesh. They performed harmonic analysis on the transducer. This helped them to compare with the theoretical results. The design frequency of the transducer is 20kHz and the error between the theoretical and finite element results is found to be less than 5% that is 19250 Hz. The application of this designed transducer is that it transforms electric energy into vibration and the vibration can be used to process hard or brittle materials to get good results. They concluded that the finite element analysis plays an important role in the structural design which can be optimized directly in it. The combination of finite element software and theoretical design has a guiding significance for practical application [34].

Tao Chen and et.al in their paper entitled “Study on a longitudinal torsional ultrasonic vibration system with diagonal slits” designed an ultrasonic vibration system with diagonal slits for vibration machining process based on acoustics propagation. The longitudinal ultrasonic vibration was transformed into longitudinal torsional composite motion by cutting off the cylinder into four uniform diagonal slits. Finite element analysis is performed on the structure to obtain the vibrational results of the structure. The dynamic characteristics of the system were numerically analysed and studied and developed a relationship between diagonal slits versus resonance frequency and the amplitudes of longitudinal torsional vibration was analysed. The optimization of the output amplitude done by rational choice of structure parameters of diagonal slits. The locus of the system obtained and proved to be elliptical in the Origin software. The resonant characteristics were determined by confirming the accuracy of the finite element model and comparing its theoretical and experimental results. They concluded that the time and cost of the designing processes of mechanical and electrical equipments was reduced by characterizing the dynamic behaviour of the vibration systems. The length of the diagonal slits affects the torsional vibration amplitudes [35].

B. T. Wang and et.al in their paper entitled “Finite element model verification for the use of piezoelectric sensor in structural modal analysis” analysed a series of rectangular PVDT films as sensors. In this paper PVDT films are incorporated on the cantilever beam and performed modal and vibrational analysis. There are two types of analysis performed on the cantilever beam i.e., finite element analysis and experimental modal analysis. In FEA, the analysis includes piezoelectric and electro-elastic vibration modes. The three-dimensional finite element method was adopted to predict the resonance frequencies and sound radiation for the piezoelectric transducer cubes. In EMA the cantilever beam is analysed by applying point force at each and every PVDT film which were fixed on it. This analysis is done by set of equations. There are 8 nodes in each element and 3 degree of freedom on each node. The PVDT film is modeled by SOLID5 element that can be used to model a 3D magnetic, thermal, electric, piezoelectric and structural field with coupling effects. The conventional modal testing is performed on the PVDT sensors which are accommodated on the cantilever beam. The hammer is actuated on eight sensors at the respective positions to excite the structure. The PVDT sensors measures the respective deformations in the beam. In this paper they validated the frequency response functions and modal parameters via theoretical and experimental modal testing [36].

Shao Jian and et.al in their paper entitled “Dynamic analysis of ultrasonic compound machining system and microstructure processing” designed an ultrasonic compound machining system for a transducer for measuring distance. They also analysed the ultrasonic compound including harmonic response and modal analysis about the transducer. In this, vibration characteristic analysis is carried out to analyse the natural frequencies and stresses of the transducer under undamped conditions. Harmonic analysis is also performed in order to determine the form factor. The obtained values are compared with the experimental optimized design. In this the piezoelectric transducer is designed with a diameter of 52mm in such a way that SOLID5 is incorporated in between SOLID185 materials. In harmonic analysis, a 600V is applied on the piezoelectric ceramic in ANSYS software. The ultrasonic transducer reached maximum displacement with a frequency of 19 kHz. They performed modal analysis on the amplitude transformer with a carbon steel c45 material. They compared the obtained results with the theoretical values by using amplitude-frequency curve. The maximum amplitude is around 15.200 kHz which is near to the 15.384 kHz. They concluded that finite element analysis provides high accuracy when compared with the experimental values. With the optimized design of different materials and electric properties provides the advantages in the processing of special shaped surfaces [37].

Jing Jing Yang and et.al in his paper titled “Metamaterial Sensors” concluded that the with the improvement of metamaterial science, detecting use of metamaterials has pulled in increasingly more consideration. The intensification of transitory wave at the limit among positive and negative refractive record materials not just takes into consideration subwavelength goals in optical imaging, yet additionally expands the affectability of the planar wave control sensors and the murmuring exhibition mode sensors because of the upgrade of the association among wave and matter. Sensors-based metamaterial exhibits and particle(s) use the nearby field improvement and resounding qualities of metamaterials to accomplish exceptionally delicate identification. Also, just rescaling the size of metamaterial particles takes into consideration the structure of sensors from microwave to optics. In spite of the fact that metamaterials can't be wiped out, lessening the size of metamaterial clusters and utilizing the stereo particles rather than the planar ones are on the whole compelling measures for decreasing the effect of misfortunes on sensor execution. We accept that with the improvement of the examination of transitory wave and the attending impacts, sensors with phenomenal affectability and sub wave length goals may be brought by metamaterials later on [38].

Yiran Tian and et.al in his paper titled “Multiband Negative Permittivity Metamaterials and Absorbers” concluded that he had exhibited a novel sort of multiband negative permittivity metamaterial made out of multibranch electric resonator. The proposed metamaterial can show four electric thunderous frequencies, that brought about four negative permittivity groups. Besides, the four electric thunderous frequencies can be tuned by changing the fundamental branches. Additionally, we planned a multiband metamaterial safeguard by utilizing the proposed multibranch resonator and numerically exhibited its absorptivity and surface current disseminations. These outcomes can broaden the plan classes of the band-improved metamaterials and the multiband applications [39].

Igor I. Smolyaninov and et.al in his paper titled “Is There a Metamaterial Route to High Temperature Superconductivity?” concluded that they called attention to that ongoing improvements in the field of electromagnetic metamaterials, for example, advancement of epsilon-close zero(ENZ) and hyperbolic metamaterials ,might be utilized to build dielectric reaction of composite superconducting metamaterials on sub-100nm scale and contended that the metamaterial way to deal with dielectric reaction designing may extensively expand the basic temperature of such composite superconductor-dielectric metamaterials [40].

Ruopeng Liu and et.al in his paper titled “Advanced Materials and Materials Genome Review Metamaterials Reshape and Rethink” concluded that in this article, we review the development of metamaterial technology in academic research and in industry. The ability to control and manipulate electromagnetic, optic, and acoustic waves differentiates metamaterials from traditional materials. With their tunability, metamaterials will be able to adjust transmission, reflection and absorption, steer beam direction, control heat conduction, and more. They will even be able to sense and respond without human interference. Metamaterials have reshaped material science. It is time for us to rethink their abilities [41].

Kazuo Sato in his paper titled “Research trend in Metamaterials” concluded that he had illustrated the ongoing patterns in metamaterials. In Topology structure streamlining strategy for electromagnetic materials has been shown by left-gave cracked wave reception apparatus for milli-meter wave applications made in late research on metamaterials at Toyota focal R&D Labs. Such metamaterials should open up another field of microwave and milli-metre wave applications for automobiles [42].

3. CONCLUSION

Metamaterials are artificially structured materials used to control and modify light, solid, and numerous other physical phenomena. The properties of metamaterials are obtained both from the inborn properties of their constituent materials, just as from the geometrical arrangement of those materials. In spite of the fact that there are numerous structures that qualify as metamaterials, the most well-known is that of arrangement of components whose size is smaller comparative with the size of spatial variety of the energizing field. Right now, reactions of the individual components, just as their associations, can frequently be fused into ceaseless, compelling material parameters, the assortment of discrete components is along these lines supplanted theoretically by a speculative nonstop material. With the advancement of metamaterial science, detecting use of metamaterials has pulled in increasingly more consideration. Sensors-based metamaterial clusters and particles use the neighbourhood field upgrade and thunderous attributes of metamaterials to accomplish exceptionally delicate discovery. Furthermore, just rescaling the size of metamaterial particles considers the structure of sensors from microwave to optics. Despite the fact that metamaterial misfortune can't be wiped out, diminishing the size of metamaterial exhibits and utilizing the sound system particles rather than the planar ones are on the whole compelling measures for lessening the effect of misfortunes on sensor execution.

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