Various Types of Antenna with Respect to their Applications: A Review

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Abstract– **Antenna is the most important part in wireless communication systems. Antenna transforms electrical signals into radio waves and vice versa. The antennas are of various kinds and having different characteristics according to the need of signal transmission and reception. In this paper, we present comparative analysis of various types of antennas that can be differentiated with respect to their shapes, material used, signal bandwidth, transmission range etc. Our main focus is to classify these antennas according to their applications. As in the modern era antennas are the basic prerequisites for wireless communications that is required for fast and efficient communications. This paper will help the design architect to choose proper antenna for the desired application.**

Keywords– **Antenna, Communications, Applications and Signal Transmission**

I. INTRODUCTION

The most fundamental parts of any electric framework is antenna. It joins the connections between the free space and transmitter or free space and the recipient [2]. Antennas are the devices which covert RF signal or electrical signal into electromagnetic or wave signal and it also use to receive electromagnetic signal and change it into electrical signal. Functionally antennas are the device use to send information in form of electromagnetic wave signal to communicate wireless or unguided way. In antenna radiating resistance affect its efficiency, if it had a high radiating resistance the efficiency of that antenna will be high.

Antennas are useful mode of communication in different fields; antennas are used to communicate in form of audio, video, graphically. As their importance in communication antennas are develop time to time according to the need. Antennas are design for different application of different materials, structures for better communication. They are design for radio, television, satellite, broadcasting, and cellular system etc., communications. It also considered essential in discovering the properties of the system where antennas are used. Different systems have different kinds of antennas employed to them. In some systems directional properties of the antennas are designed around by operational characteristics of the system, whereas the antennas are simply used to transmit electromagnetic energy in omnidirectional in some other systems or in some systems it could be used for point to point communication where increase gain and lessened wave impedance are required [45].

As the knowledge about antennas along with its application is particularly less thus this review is essential for determining various antennas and their applications in different systems. In this paper a detailed review of various types of antenna which developed to perform useful task of communication in different field of communication network is presented.

II. WIRE ANTENNA

A. Biconical Dipole Antenna

There is no restriction to the data transfer capacity of an infinite constant-impedance transmission line however any pragmatic execution of the biconical dipole has appendages of constrained extend forming an open-circuit stub in the same way as a resonant dipole. In case of transmission, radiation from the biconical transmission line make it loss so the wave reflected by the open circuit end is to some degree lessened and if the conical surface were sufficiently long, their far end would be rendered electrically "invisible" at the terminals. At the higher frequency its behavior tends toward that of a genuine biconical transmission line, the upper limit depending basically on the accuracy of the viable implementation of the 'near-coincident apices'. Between these two extremes a worthy return loss may be accomplished over an octave, or all the more, depending upon what constitutes "adequate" for the expected application for instance 10dB. Not with standing these confinement, this is still one of the simplest truly "wideband" antenna [1]. Biconical Antenna demonstrated is shown in Fig. 1.

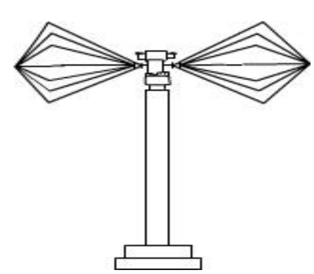

Fig. 1. Representation of the biconical antenna

B. Left Handed Dipole Antenna

Left handed dipole antennas are of new kind and it is named because its transmission is left-handed. The antenna design is based on the shunt inductors and capacitors. The capacitor is introduced on side of the line which prompts current of various amplitude on the two sides since eliminate current have diverse adequacy, they don't totally cross out in the far field, and thusly it transmit.

Left-Handed transmission line demonstrated a lessening in frequency with diminished wavelength. The receiving antenna of 0.18 wavelength in free space has an increased gain of 3.9 dBi and transmission capacity of 1.7% for |S11|<-10dB. Left handed dipole antenna shown in Fig. 2.

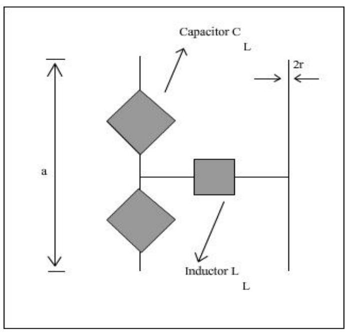

Fig. 2. Left handed dipole antenna

C. Folded Dipole Antenna

The folded dipole antenna are very simple, low cost, less covered area, easy in manufacturing and easy to install. The construction of folded dipole antenna is based on two folded wires; the folded ends of the dipole antenna are not closed. The folded dipole antennas are wide loop.

In Xin there is a wider relax-ability in adjustment of the impedance design it is vital. The impedance is does not depend on the thickness of the strip it depends on the geometry parameters. The radiation patters are same like dipole antenna [3]. Folded dipole antenna is demonstrated in Fig. 3.

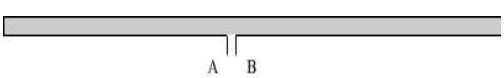

Fig. 3. Presentation of folded dipole antenna

D. λ/2 Folded Dipole Antenna

A modest, non-folded $\lambda/_2$ is termed as folded dipole whose terminal are attached to the terminal of a continuous conductor $\lambda/_2$, considered as $\lambda/_2$ dipole whose ends are attached together (Dipole B), are parallel arranged to it and present closely, The inductive coupling is created by the small separation these two dipoles, mostly $\lambda/_{10}$ or less, which induce their current equally in magnitude and direction, similar to the action of a 1:1 transformer.

Both the dipoles have resistance to radiation and their radiation resistance must be equal if they are made from same material. The current enter to the end of dipole A pass by the radiation resistance and by the 'primary' of effective transformer, that cause floe of equal current in the 'secondary' which is dipole B and its own radiation resistance [1]. Fig. 4 shows *λ/2 folded dipole antenna.*

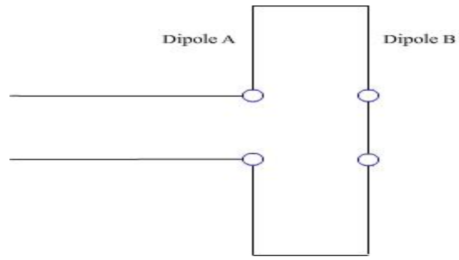

Fig. 4. Representing folded dipole antenna

E. Half-wave Dipole Antenna

The dipole antenna said to be half-wave dipole antenna when it having half wave length at output. In half-wave dipole antenna resonant frequency founded variation in sizes. The proposed antenna has full frequency of 1.995 GHz which is efficient in GSM technology. Half-wave dipole antenna exhibits range of frequency from 1.877 GHz to 2.1199 GHz.

Proposed dipole antenna is a radio antenna, wire use for its making with using of center-fed section. In half-wave dipole antenna two conductors installed in line and leave a small gap between both conductors. The voltage is attached to the center of both conductors. The length of the dipole ought to be half of the wavelength if there should arise an occurrence of half wave dipole but it is calculated as 0.45 time of wavelength practically. There are two poles of half-wave dipole antenna in which current flow. The flow of current and the voltages in the proposed antenna cause emission of the radio signal [4]. Half-wave dipole antenna shown in Fig. 5.

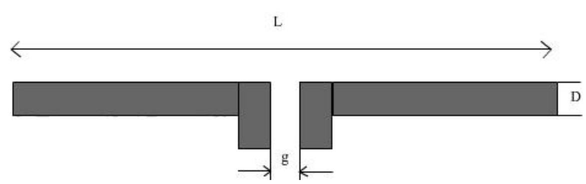

Fig. 5. Representation of half wave dipole antenna

F. L-loop Antenna

L-Loop antennas are of minimal effort, geometrically smaller and have radio effective structure as it required in ultra-wideband (UWB). It is a novel printed loop antenna as it arms have introduced L-shape portion. In UWB system antenna provides the high execution for lower band frequency, going from 3.1 GHz to 5.1 GHz. Over entire frequency band the antenna exhibits a 10dB return misfortune transfer speed. The outline of antenna depends on FR4 substrate and FED with 50 ohms coupled decreased transmission line it is watched that the L portion of loop antenna chooses the lower frequency band, though decrease transmission line chooses the upper frequency limit [5].

Fig. 6 demonstrates the structure of L-loop antenna. The total length of outer limit of the square loop Fig. 6 demonstrates the structure of the L-Loop antenna. The aggregate length of external breaking point of the square circle antenna should be in one wavelength keeping in mind the end goal to have direct enraptured radiation [6].

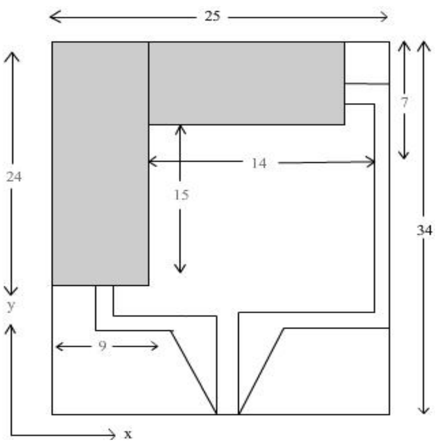

Fig. 6. Representation of L-Loop Antenna

III. TRAVELLING WAVE ANTENNA

A. Helical Antenna

In 1964 John Kraus made the helical antenna. These antennas have been known for quite a while [8], [9]. All things considered sorts of antenna comprise of single wire or limited tape wound like a right hand or left hand screw, self-supporting or turned on a dielectric cylinder [11], thus it is named as unifilar helix [10]. Due to the reason of practical emission and easy to use such antennas are extensively in practice from many years. In addition to that these antennas are widely used in getting microwaves from VHF due to their properties are extremely extraordinary and exceptional. Helical antenna used in satellite communication because in satellite communication where high gain is required. In parabolic dish higher gain is needed so helical antenna installed for this application. Propose antenna had wide bandwidth. Fig. 7 shows the helical antenna. The 50 Ohm coaxial link fed the geometry of this kind of antenna model design. It comprises of one empty dielectric chamber with relative permittivity 2.1 and distance across 61.33mm. The generator associated at the base, between the antenna and the ground plane encouraged the antenna. The feed is situated at the base of this portion [7].

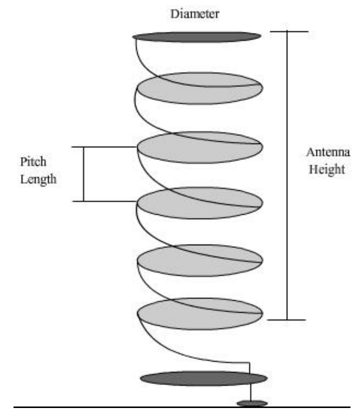

Fig. 7. Representation of helical antenna

B. Yagi-uda Antennas

The proposed antenna simply named as yagi antenna or yagi. Antenna arrangement of yagi is guided course having dipole and extra firmly coupled parasitic components which are reflector and Directors. The structure of the yagi antenna contains reflectors, dipole, and directors. These kinds of antennas are used in UHF/VHF radars, phased Doppler radars, and wind profiler system. The performance depends on these parts, reflector dipole or feeder, director [12]. Fig. 8 demonstrates the structure of the yagi-uda antenna.

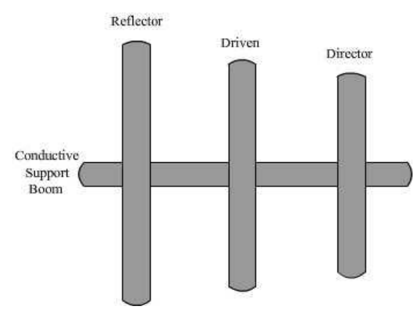

Fig. 8. Representation of Yagi-uda antennas

C. Spiral Antenna

In wireless communication system high bandwidth is needed, so need for wideband antennas rise. The propose antenna has a higher spectral competence as compared to other antenna. The benefit of spiral antenna is its simple manufacturing, led expenditure, long life, and higher emission performance. The frequency band of 3.1 to 10.6 is used by ultra-wideband radio (UWB) [13]. When contrasted with other planer antenna the spiral has great spectral efficiency, i.e., wide transfer speed [14]. It depends on Archimedes guideline for a spiral and has various shapes relying upon outline objectives. Theoretically a spiral antenna apparatus has interminable spectral proficiency and transfer speed with an endless number of turns with ideal dividing between arms. For all intents and purposes we need to deal with the way that the unfathomable size is unrealistic, and without despair the addition turns can't be excessively near one another. In proposed arrangement of the module outline different segments ought to be set on the posterior. In this way to shield part from antenna radiation a ground plane is utilized. Accordingly the antenna ought to be coordinated on a multilayer Printed Circuit Board. Frequency range 3.1 to 10.6 GHz is indicated Ultra-wideband radio (UWB) [15]. Fig. 9 demonstrates the structure of the spiral antenna.

Fig. 9. Representation of spiral antenna

D. Beverage Antenna

Beverage antennas are extensively used in many applications. It can receive signal so they can use as direction finding in frequency range from 2 MHz to 30MHz. These antennas have large directivity on low height. Beverage antennas are low cost and simple structure. The current sensing terminal receive high frequency signal which modulate a laser diode. The high frequency signal then passes through optical-fiber to the receiver and then demodulated. Hewlett-Packard 8753B network used to measure the demodulated signal. The laser output detained constant to avoid heat dependent variation in high frequency antenna system optical-fiber had great advantages as compared to the co-axial cable [16]. Fig. 10 demonstrates the structure of the beverage antenna.

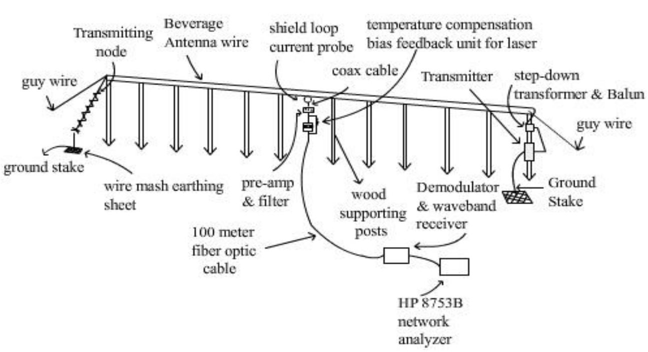

Fig. 10. Representation of beverage antenna

IV. REFLECTOR ANTENNA

A. Corner Reflector Antenna

These antennas are simple, effective, and highly efficient. The proposed antenna is made up of a dipole element and two plane reflector panels. The antenna is more directorial as this arrangement prohibits radiation in the back and side directions. A dipole or a variety of the collinear dipoles put parallel to the vertex a separation away dependably for the feed of the corner reflector, as appeared in figure 10. The feed elements are bicolical dipoles or thick cylindrical rather than thin wire in order to get greater bandwidth [18]. Fig. 11 demonstrates the structure of the corner reflector antenna.

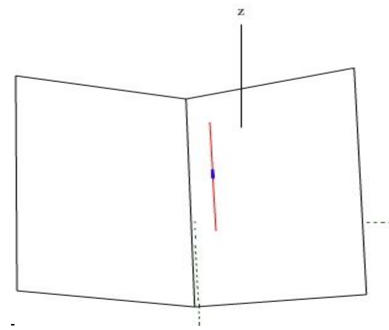

Fig. 11. Representation of corner reflector antenna

B. Parabolic Reflector (Dish Antenna)

These kinds of antennas have two different types. One of them is right cylinder and the other one is paraboloid. In cylinder type linear dipole, linear array, slotted waveguide etc. are used to feed. On other hand in paraboloid conical or pyramidal are used to feed. The radiation field pattern of the proposed antenna relies on upon the radiation pattern of the feed component put furthermore on the reflector material and measurements [19]. It is present on parabolic reflectors that gather and concentrates on parallel incoming radio wave beams and emphasize them onto the actual antenna present at its focal point on focus [20]. Fig. 12 demonstrates the structure of the parabolic reflector.

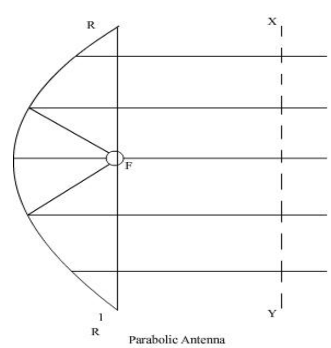

Fig. 12. Parabolic Reflector

V. MICROSTRIP ANTENNAS

A. Planer Inverted-f Antenna (PIFA)

Nowaday's need of the antenna having high bandwidth and multi bandwidth characteristics needed. It always assign that the antenna should be low cost, lesser size and solid wireless system. The planer inverted-f antenna is low profile, less size, large bandwidth and high gain. It ranges DCS-1800 and PCS-1900 bands. The dielectric FR4 suspended by a square planer element. On the base of the ground is plane of the substrate. The proposed antenna dimension is 22*22*5.2 mm3. Due to its characteristics planer inverted-f antennas are installed in cellphones. The planer inverted-f antenna are very efficient low profile antenna used in handheld devices system. They are used in many devices due to its characteristics. The devices working characteristics is better if the making is easy, emission of the signal is high, less covered area, impedance matching is less [21]. The planer inverted-f-antenna (PIFA) is shaped as the inverted-f has adjusted to the parallel part from a wire to a plate. At the frequency of operation these kinds of antenna make them reverberate structure with absolutely resistive burden impedance. The electrical execution of the antenna is influenced by tallness of the radiator, separation and area of the feed and variety of length and so forth [22]. Fig. 13 demonstrates the structure of the planer inverted-f-antenna.

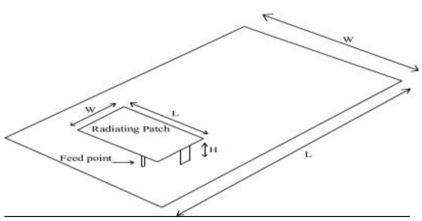

Fig. 13. Representation of planer inverted-f-antenna (PIFA)

VI. LOG PERIODIC ANTENNAS

A. Bow Tie Antennas

In communication network system the dense, effective, and low cost devices has been extremely needed. In multi-band application same characteristic required. The recent communication network required less weight, low cost, dense, moveable and easy working antennas devices. In the manufacturing of proposed antenna two mirrors required and placed on rectangular patch. For Coplanar wave guide (CPW) lumped port is used. The output limitation based on place, distance and alignment of proposed antenna. Effective applications of these antennas are mobile communication network and wireless systems [23]. Fig. 14 demonstrates bow tie antenna.

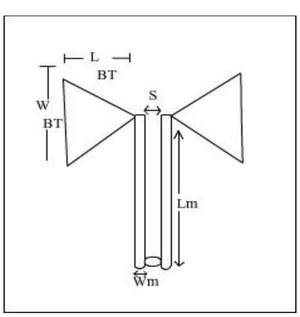

Fig. 14. Representation of bow tie antenna

B. Log Periodic Antenna

A broadband, multi-component, tight pillar, directional antenna that has radiations and impedance properties which repeat regularly as a logarithmic function of the frequency excitation is termed as log periodic antenna in telecommunication. In log periodic antenna a logarithmic increase in length and space of element occur from one terminal to the other. This kind of antenna is useful for a region which requires greater frequency ranges though it consist of directionality and moderate gain. These type antennas are design because of having wide bandwidth for specific purpose [24].

The design of antenna includes the successive dipoles which are alternately attached a balanced transmission line termed as feeder. In order to cause end case radiation in shorter direction, to these closely spaced elements are connected oppositely create element and to cancel the broadside radiation connected oppositely. Short coaxial used. Feeder is connected to the conductor of the co-axial cable its make antenna its own balun [25].

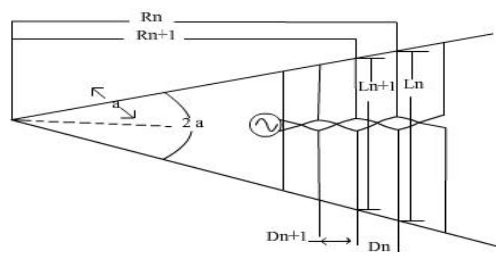

Fig. 15. Representation of log periodic dipole antenna [26]

C. Log Periodic Dipole Array Antenna

The proposed antenna is very handy if there should be an occurrence of wideband applications. The log periodic array antenna is operate in VHF frequency range from 30 MHz to 300 MHz. log periodic antenna are categories as independent antenna having bandwidth greater than 10:1. Raymond Duhamel is the first who invent log periodic array structure. Log periodic dipole array is developed by Isbell in 1960s. The characteristic of proposed antenna, the input impedance, the gain, radiation etc. Changes every once in a while in the logarithm of the frequency space. This is known as a log periodic array [27]. Fig. 16 demonstrates the structure of the log periodic dipole array antenna.

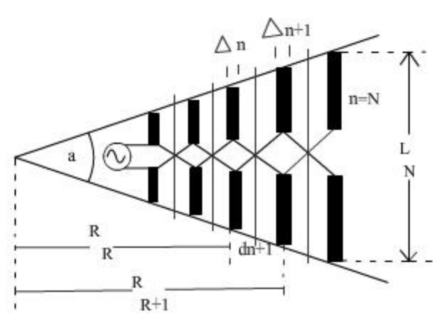

Fig. 16. Log periodic dipole array Antenna

D. Log Periodic Fractal Koch Antenna

The proposed antenna log periodic fractal koch antenna (LPFKA) are utilized as a part of ultra-high frequency (UHF) band gadgets. The antenna size can be short up-to 27% using fractal Koch process which does not affect the antenna radiation or receiving performance [28]. These days' antennas are developed in small sizes and less covered area with higher bandwidth, so the antennas are made in different direction and different shape [29].

Koch bend is a decent case of self-comparable space-filling fractal which is utilized to create wideband, multiband or scaled down antenna. The antenna helps in conquer the confinements [30]. Fig. 17 shows log periodic fractal koch antenna.

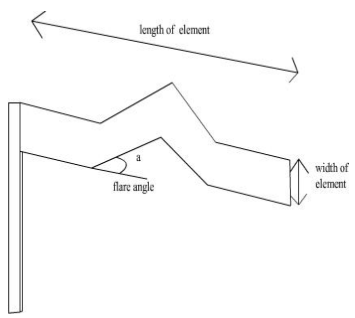

Fig. 17. Presentation of log periodic fractal koch antenna

VII. APERTURE ANTENNA

A. Inverted-f Antenna

In modern era the use of small antennas are in big demand in many commercial communication networks. The inverted-f-antenna is used in Bluetooth technology. The propose antenna is dense, simple construction, effective radiation, Omni-directional radiation patter and it operates a bandwidth of 250 MHz [31]. The normal for inverted-f-antenna is to give adaptability in impedance coordinating and it makes both evenly and vertically electric field [32]. The proposed antenna is useful for indoor communication [31]. Fig. 18 demonstrates the structure of inverted-f-antenna.

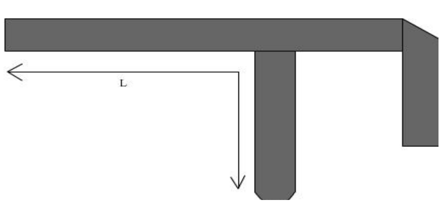

Fig. 18. Representation of inverted-f-antenna

B. Horn Antenna

The propose antenna in 1897 is first made by Jagadis Chandra Bose, which was a pyramidal horn antenna [36]. The properties of horn antenna consider as simple, it can excited by wavelength. The proposed antenna is famous as reflector antenna used as principle feed [33]. These loses are very low so we consider the gain of the proposed antenna same as directivity [34]. The horn antenna used as antenna as well as reflector. They are not correctly matched with waveguide. The horn antenna radiate constant phase font and send a greater aperture as compared with waveguide and high directivity [36]. Horn radiation gain is directly proportional to wavelength square and to the area A of flared open flange [37]. A tapered termination whose length is equal to a waveguide provides the impedance transformation between free space and waveguide impedance is referred as horn radiation.

Horn radiators act both as reflector antennas illuminators and as antenna as their own part right. These kinds of antennas are not best match to the waveguide, yet at the same time it can accomplish standing wave proportions of 1.5:1 or less. The increase of a horn radiator is corresponding to the region of the flared open rib, and conversely relative to the square of the wavelength [37]. Fig. 19 demonstrates the structure of the horn antenna.

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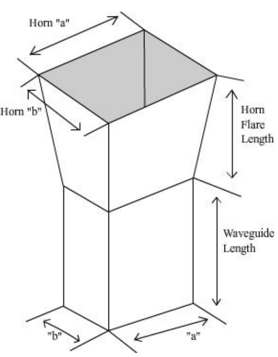

Fig. 19. Representation of horn antenna

C. Vivaldi Antenna

The proposed Vivaldi antenna was established by Gibson in 1979. The Vivaldi antennas are now used in many devices [43]. The structure of the proposed antenna is simple and low cost as well as perfectly matched, it gives high band operation. The high technology ultra-wideband (UWB) design shown in Fig. 20 is recent appropriate incorporation into existing telecommunication system and a noteworthy utilization. These antennas are used in radar application and it's also used in microwave imaging [42]. Fig. 20 demonstrates the structure of the Vivaldi antenna.

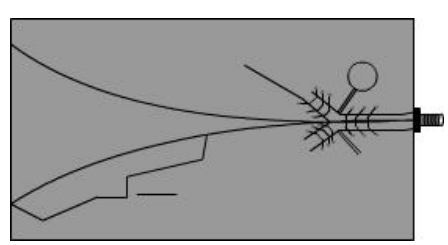

Fig. 20. Representation of vivaldi antenna

VIII. OTHER ANTENNAS

A. Wearable Antenna

The proposed wearable antenna named as wearable because it can wear by human body. These antennas are installed in clothes where they work as communication like tracking and navigation, remote computing and work for human safety. Body centric communication has become a vital role in wireless communication. Now a day's need of small size, less weight, inexpensive, long life and simple installation antennas are in greater demand.

The proposed antennas are used in medical emergency, fire-fighting and military purpose. They can use for monitoring of athletes. The antenna radiator in wearable antenna is rectangular the width is W and length of the radiator is L. the patch radiator create a small effect in radiation pattern create greater effect in input impedance and its operating band. If the radiator width increases it increase the radiation powers as well as wider the bandwidth and antenna performance [38]. Fig. 21 demonstrates the structure of the wearable antenna.

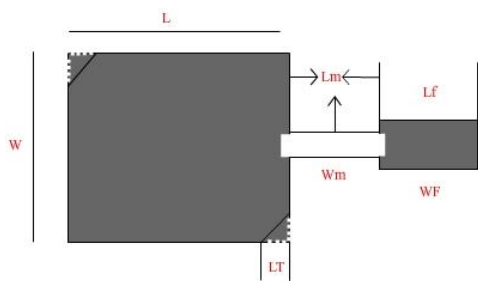

Fig. 21. Representation of wearable antenna

B. M-slot Folded Antenna

As compared to the conventional patch antenna and other modified structure M-slot folded antenna is smaller. The span of M-slot antenna ranges from 4.93-6.09 GHz band is 6*6*3 mm^3. In order to get the small size of the antenna Folded patch shorted to ground electromagnetically coupled to a parasitic shorted patch.

The outline of antenna relies on space driving a patch receiving wire. The air substrate is utilized to lessen the general size of the antenna which is associated between fundamental patch and primary ground. The ground plane size is chosen as 9*9mm2 and the beginning width of the shorting divider is 2.8mm. The principle patch is stacked by an M-slot. A bigger data transfer capacity with a superior impedance coordinating level is given by M-slot [45]. Fig. 22 demonstrates the structure of the M slot antenna.

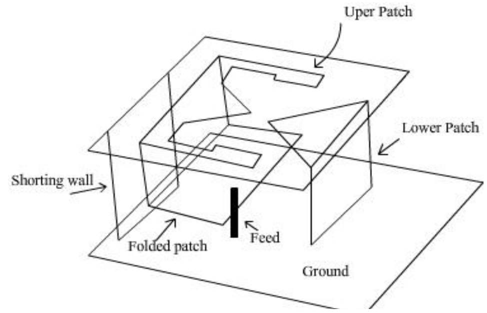

Fig. 22. Representation of M Slot Antenna

C. H.U.E Slotted Microstrip Antenna

H.U.E slotted microstrip antennas are made for wireless communication which includes Wi-Fi, Bluetooth and wireless LAN (WLAN). In order to carry out efficient wireless communication three distinct slots namely H, U, and E are provided to antenna. Additionally all three slots are equal in length, width, thickness as shown in figure 22. The resonance frequency of the proposed antenna ranges from 2.0-6.3 GHz along with main frequency of 4.2 GHz. The return loss provided by HUE antenna is approximately -30dB. The antenna is sustained with coaxial feeding yields an impedance bandwidth of 103.6% and VSWR of under 1.07 [39]. As wireless communication technology is massively raise from past few years so major challenge for antenna design researches include design of compact, low profile and wideband antennas [40]. Fig. 24 demonstrates the structure of the HUE slotted microstrip antenna.

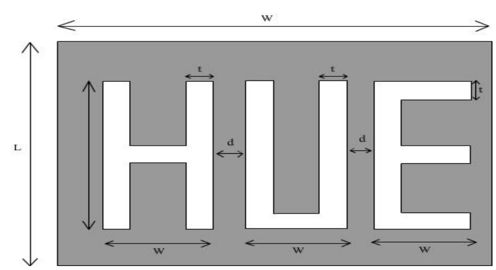

Fig. 23. Representation of HUE Slotted Microstrip Antenna

IX. CONCLUSION

Study concluded gives vast information about different types of antennas. According to the required wireless communication system we can select the best antenna to fulfill the requirement with the help of this research paper. In this paper, applications and working of antennas are study according to their groups.

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