

# Wi-vi Technology-a Review

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**Abstract:** —Wi-Fi is a popular technology, which allows an electronic device to connect with the internet wireless using radio waves. Wi-Fi signals are nothing, but the information carriers between transmitter and receiver. Wireless Vision (Wi-Vi) is a new technology similar to the same concept of Wi-Fi which enables through walls with the help of Wi-Fi signals. Wi-Vi allows us to track moving humans through wall as well as behind closed doors. Wi-Vi's operation does not require to access any device on the other side of the wall. Wi-Fi can enable us to see moving objects through walls and behind closed doors. So particularly, we can use such type of signals to identify the number of people in a closed room and their relative locations also.

**Keywords:** Gesture-Based User Interface, MIMO, Seeing Through Walls, Wireless.

## I. INTRODUCTION:

This paper gives an idea about the potential of using Wi-Fi signals. There are recent advantages in MIMO communications to build a device or a system that can capture the motion of humans behind a walls and doors in closed room. Law enforcement personnel can use this device to avoid walking into a scupper and minimize casualties in hostage situations. Emergency responders can be using it to see through the collapsed structures or debris. The advantages of this for ordinary users are the device for gaming, usurpation detection, privacy-enhanced monitoring of children, elderly or personal security when stepping into dark lanes and unknown places. The concept of this seeing through opaque obstacles is similar to sonar and radar

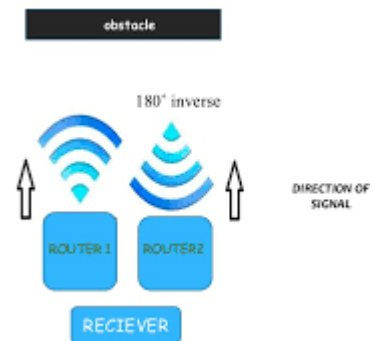


Fig 1

Wi-Fi signals are typically information carrier signals between a transmitter and receiver. Now it is possible with the Wi-Fi signals can also extend in our senses [1]. Wi-Fi enable us to see moving objects through walls as well as behind the closed doors. So, it is possible with the help of this type of signals to identify the number of people room and their relative locations in a closed room. We can also identify motion made behind a wall and combine the sequence of motion to communicate messages or commands to a wireless receiver without carrying any type of transmitting device. Wi-Vi means “Wi-Fi” and vi means “Vision” which is nothing but wireless vision. It is a new promising technology that enables seeing through walls using Wi-Fi signals. It also allows us to track moving an objects or human through closed rooms and behind the walls. Wi-Vi based on capturing the reflection of its own transmitted signals off moving objects behind a walls or doors in order to track them. Wi-Vi operation does not require any type of access to any device on the other side of the walls. Specifically, when it is interact with a non-metallic walls, some form of

the RF signal would traverse the walls, reflect off objects and humans. It come back with a signature of what is inside a closed rooms. By capturing these reflections, it is possible to image objects behind a walls or door.

Building a Device or system that can such reflections is difficult because the signal power after penetrating the walls twice (in and out of the

#### A:-Through Wall Radar:

There is growing interest in through-walls imaging for about a decade. Earlier work in this area focused on the simulation and modeling. Recently there are some design implementations tested with moving humans. These past design of systems or devices eliminate the flash effect by doing isolation of the signal reflected off the wall from signals reflected off objects behind the walls. This isolation can be achieve in time domain with the help of very short pulses (less than 1ns). Where the pulses reflected off the walls arrives earlier in time than that reflected off moving objects behind it due to the distance travelled. It can also be achieve in the frequency domain by using a linear frequency chirp signal given by L. Kempel, E. Rothwell, C. Coleman, G. Charvat and E. Mokoleetal in 2010. In this scenario, reflection off objects at different distances come with different tones. By doing analog filtering the tone that corresponds to the walls, one can remove the flash effect. These techniques require ultra-wide bandwidths (UWB) of



Fig 2

Wi-Vi technology is different from the above system. In that Wi-Vi, it requires

walls) is reduced by three to five times of magnitude. Even the difficult challenge is the reflection from the wall itself, which is stronger than the reflection from objects inside the room.

#### II. RELATED WORK:

Wireless Vision i.e. Wi-Vi is related to past work in major three -

only few MHz of bandwidth and operates in the same range which is required for Wi-Fi. This technology removes the flash effect by leveraging MIMO nulling so it does not require UWB (ultra-wide bandwidths). Researchers have recognized the limitations of UWB (ultra-wide bandwidths) systems. They also describe the capacity of using narrowband radars for through wall caused by moving objects behind the walls and doors. However, the flash effect affects on the detection capabilities. Hence, most of the systems are demonstrated either in simulation, modeling or in free space with no obstruction. Wi-Vi has the some objectives of these devices. It gives a new method for eliminating the flash effect without wideband transmission. This enables to work with concrete walls, solid wood doors and also fully closed rooms. The attempt which we are aware of that uses of Wi- Fi signals in order to see through walls was made in 2012. This system needs both the transmitter and reference to the receiver to be inside the imaged room. Then, the reference receiver has be connected to the same clock as the receiver outside the room and Wi-Vi can operate through-walls imaging without any access to any device on the other side of the walls.

#### B. Gesture-based interfaces:-

Today's commercial gesture recognition systems such as the Nintendo Wii, Xbox Kinect, etc. Can identify a wide variety of gestures. The academic community is also

developed some systems capable of identifying human gestures either by using cameras or placing by sensors on the human bodys. Recent work has also leveraged narrow band signals in the 2.4 GHz range to identify human activities in line-of-sight using micro-Doppler signature [1]. Wi-Vi technology presented in the first gesture-based interface that works in non-line-of-sight scenarios, and also through a walls. This technology does not require the human to carry any wireless device or wear a set of sensors. whose wavelengths are nearly 12.5 cm<sup>3</sup>. In (a), an antenna array is able to locate an object by steering its beam spatially. In (b), the moving object itself emulates an antenna array; so from this fact it acts as an inverse synthetic aperture.

*C. Infrared and thermal imaging:-*

Similarly, Wi-Vi, these technologies develop the human vision beyond the visible electromagnetic range. It also allows us to detect objects in the smoke or in the dark.

Fig1. A Moving Object as an Antenna Array  
They operate by capturing or collecting infrared or thermal energy reflected off the first obstacle in line-of-sight of their sensors. However, cameras based on these technologies cannot see through walls because they have very short wavelengths in few  $\mu\text{m}$  to sub-mm, whereas Wi-Vi which employs signals whose wavelengths are

#### IV. ELIMINATING THE FLASH:-

In every through-wall system, the signal reflected off the wall which is nothing but the flash, is much stronger than any signal reflected from objects behind the wall. This is due to the attenuation which electromagnetic signals suffer when penetrating through the dense obstacles. Table 1 shows some of the examples of the one-way attenuation experienced by Wi-Fi signals in construction materials. For example- once the signal is traversed

nearly 12.5 cm<sup>3</sup>. In (a), an antenna array is able to locate an object by steering its beam spatially. In (b), the moving object itself emulates an antenna array; so from this fact it acts as an inverse synthetic aperture.

#### III. WI-VI OVERVIEW:-

Wi-Vi technology is a wireless device that capture moving objects behind a walls and doors. Wi-Vi has the strategic advantage of Wi-Fi to make through walls imaging relatively low cost, low power, low-bandwidth, and accessible to average users. Wi-Vi uses the Wi-Fi OFDM signals in the ISM band i.e. at 2.4 GHz and typical Wi-Fi hardware. Wi-Vi is basically a 3-antenna MIMO device in which two antennas are used for transmitting and one is use for receiving. This also includes directional antennas to focus on the energy toward the walls or rooms of interest. Its design includes two main components:

- 1) The first component is used to eliminate the flash reflected off the walls by performing MIMO nulling.
- 2) The second component is used to track the moving object by treating the object itself as an antenna array using a technique called inverse SAR i.e. ISAR. Wi-Vi can be used in one of above two modes. It depends on the user's choice.

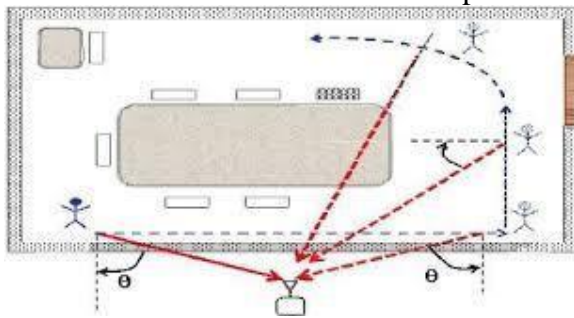
Through solid wood doors or interior hollow walls, the Wi-Fi signal power are reduced by 6dB and 9dB. As mirrored signal on each the reflection constant because the cross-sectional of objects owing to that the particular mirrored signal becomes weaker. Hence, Wi-Vi increases the sensitivity of the reflection to the interest by victimization the development of nulling the interference or by power boosting.

#### V. IDENTIFYING AND TRACKING HUMANS:-

Since, the elimination of the impact of static objects are describe. So, now focus on moving objects as humans.

#### A. Tracking A Single Human:-

In advanced, through all systems antenna array is employed to trace the human motion. They steer the arrays beam to see the direction of most energy and this direction corresponds to the signals abstraction angle of arrival. By following that angle of time, it is possible to infer however the thing moves in area. However, Wi-Vi avoid using an antenna array for two reasons: First is, in order to obtain a narrow beam that means achieve a good resolution, one need a large antenna array with many antenna elements. This would result in a bulky and expensive device. Second is, since Wi-Vi eliminates the flash effect using MIMO nulling, adding multiple receive antennas would require nulling the signal at each of them. This requires adding more transmit antennas so the device will become bulkier and more expensive.



#### B. Tracking Multiple Humans

With multiple human, the noise increases significantly. On one hand, each human is not just one object because of different body parts moving in a loosely coupled way and on the other hand, the signal reflected off all of these humans which are correlate in time, hence they all are reflect the transmitted signal. The lack of independence between the reflected signals is important. For example, the reflections coming from two

humans may combine systematically to dim each other for some period of time.



#### VI. THROUGH WALL GESTURE-BASED COMMUNICATION

Wi-Vi can enable human who does not carry any wireless device to communicate short messages or commands to a receiver using simple gestures. Wi-Vi represents these try of gestures by „0“ bit and „1“ bit. These gestures are later composed by human to make messages that are having completely different interpretations. In addition, Wi-Vi will develop by exploitation different existing practices and principles like adding an easy code that may guarantee dependability, or by reserving an exact pattern of „0“ and „1“s. At this stage this technology continues to be terribly basic, nevertheless we have a tendency to believe future advancement scan build it a lot of reliable and communicative.

#### VII. ADVANTAGES

First advantage is, this system uses only one receiver still effectively measures the time it takes for the signals to reflect to the calculated exact location. Second is, with low cost Wi-Fi technology system can be utilized in disaster recovery and gaming activities. And lastly, Wi-Vi technology, as a gesture-based interface, does not require a line of sight between the user and the device.

CONCLUSION:-

We discussed Wi-Vi, a wireless technology that uses Wi-Fi signals to detect moving humans behind walls or doors and also in closed rooms. As compared to previous systems, which are targeted for the military, Wi-Vi enables the small cheap see-through-walls devices which operate in the ISM band, rendering them feasible to the general public. Wi-Vi also builds a communication channel between a human behind a wall or in a closed room and device itself, allowing person to communicate directly with Wi-Vi without carrying any of transmitting device. We believe that Wi-Vi has a set of functionality that future Wireless networks will provide. Future Wi-Fi networks will likely expand beyond communications and deliver facilities such as indoor localization, sensing as well as control. Wi-Vi gives evidence of advanced form of Wi-Fi-based sensing and localization by using Wi-Fi to track humans behind walls without carrying any wireless device.

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