Study and Predicated of Signals and Noise Pollution during Ziyarte Al-Arbaeen Compared to normal days

Zina Fadel kahdim

Department of Astronomy and Space, College of Science

University of Baghdad, Baghdad ,Iraq

Zina.kadhim@sc.uobaghdad.edu.iq

Kamal M. Abood

Remote sensing and geophysics College of Science

al-karkh University, Baghdad, Iraq

Kamalabood@sc.uobaghdad.edu.iq

Abstract

Radio-frequency interference (RFI) in radio telescope observations refers to the level of radio-frequency noise in the sky at all times, regardless of any astronomical sources this noise may be coming from including the Earth's atmosphere and solar activity as well as all communications equipment near the areas of interest. Make it radio-quiet and reduce or reduce noise pollution in it in order to preserve people's health, as well as provide a quiet monitoring area within the same range of these frequencies.

In this study, we designed two dipole antennas in different frequency bands to measure the radio noise level. The research can focus on studying the levels of signals and noise pollution resulting from interference within the same frequencies during normal days to compare with the days of religious visits in different regions of Iraq, especially Karbala Governorate, to study the effect of signals and noise pollution on public health and the health of visitors in particular during the performance of the visit due to the presence of gatherings great humanity. The project may also include a study of the possibility of media coverage of the event within the same frequencies and an attempt to reduce the negative impact of radio interference and the effect of signals and noise pollution during religious visits, as the use of mobile phones may lead to an increase in noise levels and a decrease in the sound quality of the coverage. This research can contribute to identifying the negative effects of signals and noise pollution during religious events and identifying measures to reduce these effects on visitors.

With our antenna design, the quality and working performance of the antenna was measured by measuring the impedance (Z) and the standing wave ratio (SWR). Our coaxial cable has a characteristic impedance of 80 Ω for LBA and about 50 for HBA and SWR Range Explanations between (1.0-2.0) for HBA and about 1.5 for LBA, which is a good match for the bipolar half-wave.

The radio interference ratio was measured during different days and times to find the amount of variation on normal days, where the morning LBA value is -76.232±0.7733.and the HBA .0.6814±68.7106, also, in the afternoon the value is about -77.4956 1.06541 and -72.7847±1.1583 for LBA and HBA, respectively, as well as the measured nighttime -82.352±0.5066 and -82.7397 0.4997 for LBA I'm HBA, respectively. When comparing these values, note that they are higher in the morning for both LBA and HBA.

In an actual attempt to determine the percentage of radio noise, we will use the aforementioned antennas to make the same measurements during Ziyarte Al-Arbaeen to determine the extent of the impact on the RFI value caused by the number of visitors and thus its impact on the quality of communications. Where the radio interference is commensurate with the large number of radio devices used by the security and service agencies supporting Ziyarte Al-Arbaeen and studying the possibility of reducing its effects on the health of visitors first, as well as the extent of its impact on radio monitoring in the event of installing radio telescopes close to the area.

Keywords: radio frequency interference, a dipole antenna, Ziyarte Al-Arbaeen, communications.

Introduction

Radio signals are weak of man-made radio signal noise, or a sign that interferes with blocking radio astronomers' signals is called radio frequency interference (RFI) [1] In radio reception, radio noise is defined as unwanted random RF electrical signals and fluctuating voltage, which are always present in the radio receiver in addition to the desired radio signal [2,3]. for observed RFI, by using LOFAR telescope which is a large radio interferometer operating in the frequency range 10-240 MHz (corresponding to wavelengths of 30.0-1.2 m) contains two dipole antenna fields: LBA (Low Band Antennas) and HBA (High Band Antennas)[4,5]. The LBA operates in the frequency range 15-80 MHz The HBA antennas the frequency range 110-240 MHz [6]. The dipole antenna consists of two identical conductive elements, such as metal wires or rods. The driving current from the transmitter is applied, or for receiving antennas, the output signal to the receiver is taken between the two halves of the antenna and displacement and adjustment of the antenna is a hassle [7]. the reason for chose dipole antennas offer the advantage of receiving balanced signals from various frequencies. It also helps the device sort out problems caused by conflicting signals without losing reception quality [8]. Noise pollution is a major problem in urban environments, affecting human behavior, well-being, productivity and health [9]. Nowadays assessments of environmental noise in urban areas are mainly carried out by officials who collect data at a sparse set of locations, e.g., close to roads, railways, airports and industrial estates, by setting up sound level meters during a short period of time [10]. Studying signals and noise pollution during the visit of Al-Hussain Arbaeen is an important topic that attracts the attention of many researchers and experts in communications and the environment where Arbaeen is characterized by heavy visitor attendance and high traffic flow and poses significant challenges regarding the area's wireless signal quality and noise pollution therefore, studying this phenomenon and analyzing the effects that may result from it is necessary to determine the necessary procedures to improve the quality of signals and reduce noise pollution during this religious visit [11, 12]. In terms of noise pollution, large gatherings of people at religious events can increase noise levels in the surrounding area, especially if loudspeakers and other audio devices are used. This noise pollution can affect the environment and wildlife in the surrounding area, as well as human health and quality [13,14]. This study aims to analyze the signals and noise pollution during the Arbaeen visit and compare them to normal days, using the latest technologies and devices for data collection and analysis. The results of this study can be used to determine the necessary measures to improve signal quality, reduce noise pollution during the Arbaeen visit, and provide a healthy and safe environment for visitors and residents in the area.

Design of Half Wave Dipole Antenna

to measuring the variation of RFI which effect on visitors, we designed two dipole antennas in different frequency bands: a low-band antenna (LBA) with a frequency range (15-80MHz) and a high-band antenna (HBA) (110-240MHz), which is connected to a series receiver spectrum analyzer. HSA2000, for radio background level measurement for design dipole antenna which include two conductive elements like wires and rods or wires, The conductive element in the antenna is split in the middle into two sections through an insulator which is called an antenna section. These sections are connected to a coaxial cable or feeder in the middle of the antenna and there is a gap between two arms of half-wave dipole antenna for feeding purpose. Through antenna design, the dimension of an antenna frequency Through our antenna design, the dimension of an antenna frequency (f), for low band 20.1 MHz and high band 90MHz has been chosen. Here, the radiation resistance of the half-wave dipole is ≈ 50 Ohm, which matches the line impedance by using the fundamental equations for design antenna the wavelength (of dipole can be calculate by using (1) equation depending on radio signal frequency.

by calculate the wavelength for low band antenna:[8]

$$\lambda = \frac{c}{f} = \frac{3x10^8}{20x10^6} = 15 \quad m \;\ldots\ldots\ldots\ldots\; (1)$$

and the wavelength for high-band antenna

$$\lambda = \frac{3x10^8}{90x10^6} = 3.3\ m$$

then, the length of the dipole antenna(L) has been found from the equation (2).

$$L = \frac{\lambda}{2} = \frac{15}{2} = 7.5\ m \ldots\ldots\ldots\ldots\ldots (2)$$

$$L = \frac{\lambda}{2} = \frac{3.3}{2} = 1.65\ m$$

the length of wire that we used is less than the obtain length for both LBA and HBA because of the resistance of the wire used in the manufacture of the antenna, which affects the inductive current

The feeding gap (g) and wire radius (R) were calculated from equations (3) and (4), respectively for both low band antenna and high-band antenna

$$g = \frac{L}{200} = \frac{7.5}{200} = 37.5\ mm \ldots\ldots\ldots (3)$$

$$g = \frac{L}{200} = \frac{1.65}{200} = 8.25\ mm$$

$$R = \frac{D}{2} = \frac{3}{2} = 1.5\ mm.......(4)$$

$$R = \frac{D}{2} = \frac{5}{2} = 2.5\ mm$$

Parameter	Value of LBA	Value of HBA	Unit
Frequency *(f)*	20	90	MHz
Wavelength (λ)	15	3.3	M
Average Impedance	50	49	Ohm
Length of the dipole (L)	7.5	1.65	M
Radius of the dipole (R)	1.5	2.5	Mm

Table (1): Design Parameters of the Antenna

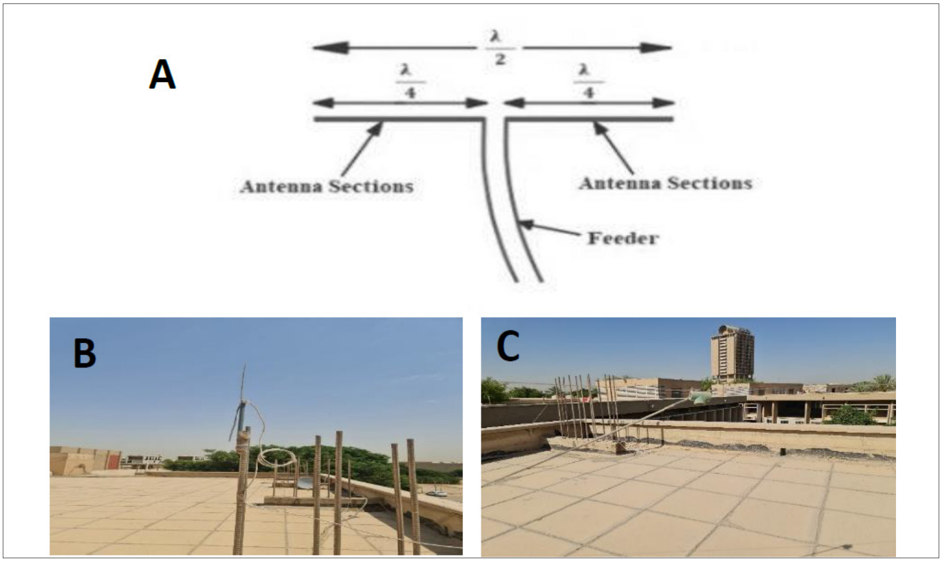

figure (1): (A) The basic Half-wave dipole antenna diagram. B) actual designing for our antenna for high band antenna(HBA) (C) actual designing for our antenna for low band antenna(LBA)

Component Basics to Receiving Background or Radio Signal

When we design our antenna, which is the main component of our telescope, we test these tools and exams the main feature of any antenna, which are Antenna impedance (Z(Ω)) and Standing-wave ratio (SWR), by Vector Network Analyzer (VNA) which is a handheld with a small outline, initially designed by edy555. It is a low-cost yet high-performance (at its price point) VNA with an LCD and can be powered by a 3.7V Li-ion battery. also, by using the HSA2000 series spectrum analyzers, the electromagnetic wave flowing over the dipole antenna at the receiver section will induce a small voltage with a Frequency Range: of 9 kHz to 3.2 GHz. as shown in figure (2).

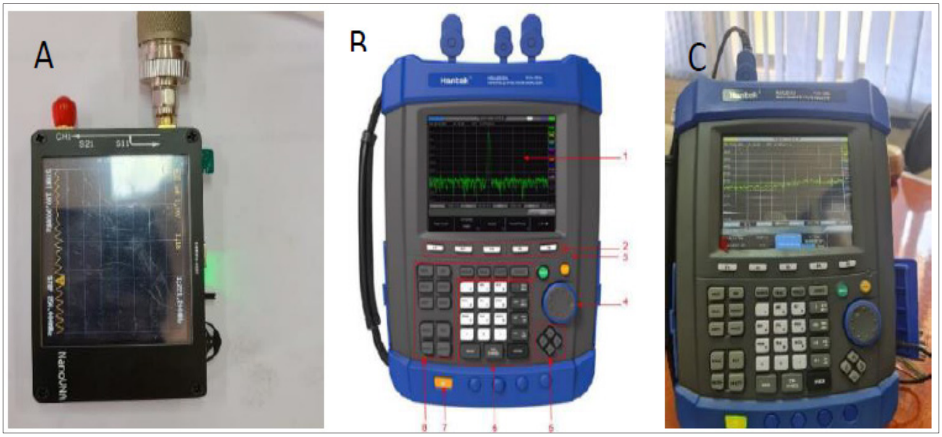

figure (2): A) handheld Vector Network Analyzer (VNA) with small outline, originally designed by edy555. B) The HSA2000 series spectrum analyzers are 1.LCD 2. Menu softkeys/menu control keys 3. Charge indicator (Only lights up when charging 4. Knob 5. Direction keys 6. Numeric Keyboard 7. Power switch (Lighting normal work status) 8. Function key area C) Real picture of the HSA2000 series spectrum analyzers from our laboratory

The Impedance (Z) matching between transmission lines and antennas is an important and fundamental concept in electromagnetic theory or the resistance and reactance the antenna terminals or the ratio of electric to magnetic fields so we designed for LBA and HBA as shown in figure (3A), (3B). Our coaxial cable has a characteristic impedance of 80 Ω for LBA and about 50 Ω for HBA which wo a good match for a half-wave dipole. Also, when designing the antenna, the other parameters must test these tools and exams the main feature of any antenna, which is the Standing-wave ratio (SWR), which is defined as the ratio of the maximum radio-frequency (RF) voltage to the minimum RF voltage along the line or in the other word it's matching between transmission lines and antennas is an important and fundamental concept in electromagnetic theory. At the same time, it is a mathematical expression of the non-uniformity of an electromagnetic field (EM field) on a transmission line such as a coaxial cable. Usually, SWR Range Explanations between (1.0-2.0) are the ideal range when SWR is under 1.5 and want to drop closer to 1 due to additional tuning, different equipment, or a different mounting location. Figure (3C), (3D), represents the measuring Standing-wave ratio (SWR) for antennas we designed for LBA and HBA.

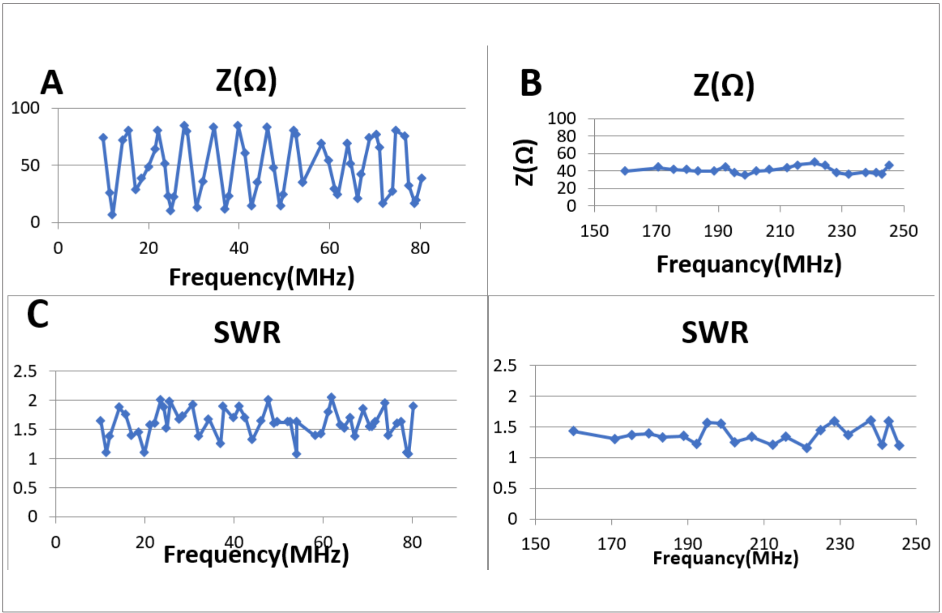

Figure (3): (A) the Impedance antennas designed for LBA (B)the Impedance antennas designed for HBA. (C) Standing-wave ratio (SWR) for antennas designed for HBA. (D) Standing-wave ratio (SWR) antennas designed for LBA.

Interference Radio Signals Testing in Baghdad

To compare Interference Radio Signals, in regular and eclipsing day we must test our antenna (LBA and HBA) in Baghdad governorate, so we test the ratio of the signal on different days and times the limiting noise source in a receiver depends on the frequency range in use.

For both LBA and HBA measuring the radio spectrum presented the power obtained from background noise (radio stations, mobile, communication towers. etc.) and the desired radio signal. The background noise is measured by unit dBm/ Hz/s, which is calculated as a negative value according to the equation:

$$dB_m = 10\log(\frac{1}{power}) \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where

dB_m = logarithm scale of power

The device measured the power in this scale to receive a broad signal range, such as faint and robust signals, because it has high sensitivity and accuracy.

The first Interference Radio signals test was carried out for different days in Baghdad on (5/9/2022) for both LBA and HBA by measuring the radio spectrum during the morning period (9:00-12:00) AM Iraqi local time (+3 GMT) at a rate of four observation per hour which contain 461data for each quarter of an hour during specific frequency.

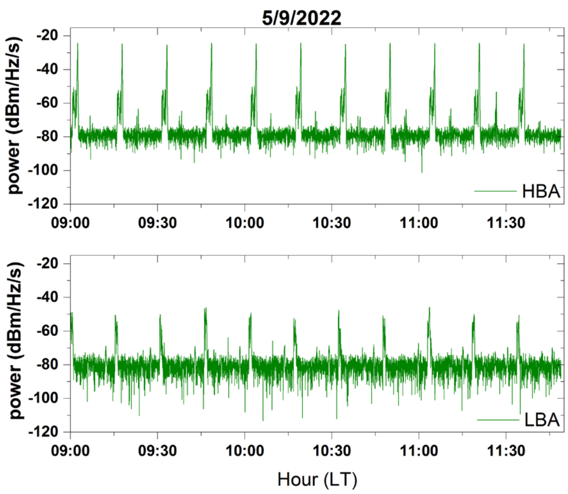

Figure (4): the power of radio signal (background noise) during morning period for LBA and HBA

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From figures (4), the observation background noise level ranges from about > -80 for both the HBA and LBA observations. We note that the power behavior for the previously mentioned date is approximately constant with time. Also, the power value is the highest because of this radio frequency band's different and massive during the morning observation time. Also, comparing LBA and HBA background noise in Baghdad, the HBA value is higher, which means the signal power is lower and vice versa. In addition, the value of LBA is higher than HBA because this range is more for being the most used in mobile communication, fixed ground services, amateur, and the military.

the value in the morning for LBA:

$$ave = -76.232 \mp 0.7733$$

The value in the morning for HBA:

$$ave = -68.7106 \mp 0.6814$$

Also, a study was carried out for different days (7/9/2022) in the afternoon for LBA and HBA by measuring the radio spectrum at (12:00-14:30) PM local Iraqi time (+3 GMT) at a rate of four observations per hour where the spectrum presented the power obtained from background noise. Furthermore, to determine the power, as shown in Figure (5).

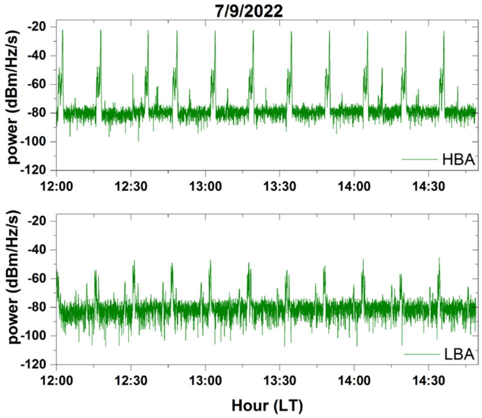

Figure (5): the power radio signal (background noise) during afternoon

The power's behavior for all days is approximately symmetric for the morning in value and behavior. The value in the afternoon for LBA:

$$ave = -77.4956 \mp 1.06541$$

The value in the afternoon for HBA:

$$\text{ave} = -72.7847 \mp 1.1583$$

Also, an Interference Radio signals test was carried out for different days in Baghdad on (2/10/2022) for both LBA and HBA by measuring the radio spectrum during the night time (16:00-18:30) PM local Iraqi time (+3 GMT) at a rate of four observation per hour which contain 461data for each quarter of an hour during specific frequency.

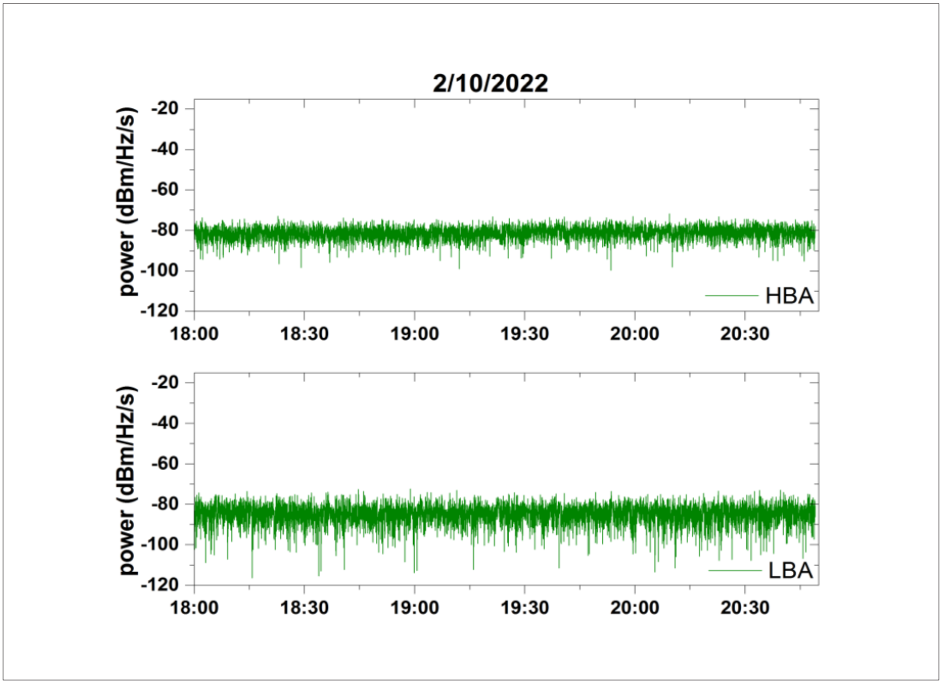

Figure (6): the power radio signal (background noise) during nightv

Figure (4-6) shows smooth behavior for both LBA and HBA, where the reason could be at night, the ionosphere experiences a decrease in plasma density at all altitudes because the production of ions is significantly attenuated. In contrast, recombination rates of electrons and ions remain high, especially at low altitudes where the recombination process is fast and lack of surrounding noise.

night for LBA:

$$ave = -82.352 \mp 0.5066$$

The value at night for HBA:

$$ave = -82.7397 \mp 0.4997$$

These values show that the average background noise measuring the difference between different times, despite the convergence of importance, is a logarithmic difference that's mean 10dBm; also, when compared between these values, note that it is higher in the morning for both LBA and HBA.

After applying all the determinants on the map of Iraq and taking into account all the influences that cause noise on the signal and which can limit the selection of the monument area, the results of the spatial analysis of the governorates of Iraq showed that four Iraqi governorates that can establish a monitoring station on low frequencies, are Nineveh, Al Anbar, Najaf, and Al Muthanna. The research will deal with each governorate with regard to coordinating the parameters and defining the appropriate area for building the station and monitoring. By studying the candidate governorate for installing the binoculars, and because the goal is to build a radio telescope in an area completely far from the causes of noise and radio interference, and for this reason a buffer zone was established in the empty areas of each governorate by leaving a distance of 20 km from

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the nearest communications tower, and then leaving 10 km from the borders of the zone free of any influence as a future safety distance. The research came to identify the best areas in these governorates for the installation of radio telescope antennas. Despite the proximity the distance, and the nature of Karbala governorate, similar to Najaf governorate in terms of religious and social character, it was found that Karbala cannot be considered among the suitable areas for radio monitoring due to the high noise on normal days and the most increase during the Arbaeen visitation period causes of interference (increase the number of population and thus communication equipment, etc. where excessive noise may affect the ability to hear speakers clearly, making it difficult for reporters and editors to record information and content accurately and clearly. High noise levels also increase the chances of disturbances in wireless communications, leading to dropped connections or reduced picture and sound quality.

Discussion

It is possible to link the visitor service for religious events with noise pollution and astronomy by looking at the environmental impact of religious events, especially those that include large gatherings of people and their many uses of mobile devices, and reduce them. For this purpose, we designed a new and innovative radio telescope dipole antenna to open the lower frequency radio system to a wide range of astrophysics studies capable of operating in the 10-240 MHz to measure RFI measured a regular day during the afternoon and night.

The smooth behavior for both LBA and HBA at night could be that the ionosphere experiences a decrease in plasma density at all altitudes because the production of ions is significantly attenuated. In contrast, recombination rates of electrons and ions remain high, especially at low altitudes where the recombination process is fast. The research can focus on studying the levels of signals and noise pollution during normal days and the days of religious visits in a specific area, and the available data can be analyzed from environmental monitoring stations located in the region. It is also possible to study the impact of signals and noise pollution on general health and well-being during religious visits and to compare them to normal days. This can be done by conducting surveys with residents and visitors who attend religious events to assess the impact of signals and noise pollution on individuals' religious experience and mental health. The project could also include studying the social and environmental impact of signals and noise pollution during religious visits and the extent of their impact on the infrastructure and environment surrounding religious sites. This research can contribute to identifying the negative effects of signals and noise pollution during religious events and identifying actions to maintain public health and well-being during these events.

Conclusion

By measuring the radio noise in Baghdad, it was found that it is a high-noise area, and to compare the results with Karbala governorate, which is similar to Baghdad in terms of radio interference on normal days and the days of Ziyarte Al-Arbaeen, due to the use of phones, which is considered one of the most important causes of interference that affects the coverage of the visit event by adding noise pollution to the environment audio and reduce the quality of the audio coverage. Since the visit may include large gatherings of people, to reduce this negative impact, some measures can be taken, such as placing restrictions on the use of mobile phones during coverage and instructing attendees not to use mobile phones at certain times. Noise filtering and sound quality improvement equipment can also be used for audio and video coverage.

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