DESIGN OF SMALL AUDIO BUG DEVICES

A MINOR PROJECT- II REPORT

Submitted By

MIDHUN.R (927621BEC120)

KAVINESH. A.S (927621BEC081)

BALAKUMAR.A (927621BEC302)

MOHAMED ANAS. S (927621BEC121)

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BONAFIDE CERTIFICATE

Certified that this 18ECP104L - Minor Project II report " DESIGN OF SMALL AUDIO BUG DEVICES" Is the bonafide work of "MIDHUN.R(927621BEC120), KAVINESH. A.S(927621BEC081), BALAKUMAR.A(927621BEC302), MOHAMED ANAS. S (927621BEC121)" who carried out the project work under my supervision in the academic year 2022-2023 / Even.

SIGNATURE

Dr. S PALANIVEL RAJAN M.E., Ph.D., D. Litt(USA).,
HEAD OF THE DEPARTMENT,
PROFESSOR,
Department of Electronics and Communication Engineering,
M. Kumarasamy College of Engineering,
Thalavapalayam, Karur-639113.

SIGNATURE

Mr. L RAMESH , M.E.,
SUPERVISOR,
ASSISTANT PROFESSOR,
Department of Electronics and Communication Engineering,
M. Kumarasamy College of Engineering,
Thalavapalayam, Karur-639113.

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PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produces smart technocrats with empirical knowledge who can surmount the global challenges

M2: Create a divers, fully engaged, learner-centric campus environment to provide quality education to the students

M3: Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: Core Competence: Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering.

PEO2: Professionalism: Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: Lifelong Learning: Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfill the industrial expectations.

Abstract	**Matching with POs, PSOs**
DESIGN OF SMALL AUDIO BUG DEVICES	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2

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ABSTRACT

Audio spy bugging devices are used by intelligence agents in different parts of the world. These devices can help hear conversations from a distance. Their size is extremely small which helps them fit into a pocket and even inside a pen. Similarly, we designed an FM audio bug spy device whose range is up to (1km or even more). The audio is both transmitted and received via frequency modulation. Wireless spy devices (WSDs) are surveillance equipment, such as listening bugs or cameras, hidden in objects or covertly placed in rooms. Surveillance using WSDs is one of the main methods of recording conversations for both intelligence gathering as well as criminal charges. However, WSDs have also been abused for nefarious purposes, such as industrial espionage and blackmail. This paper is aimed at reviewing WSD technologies, in terms of types, energy sources and modes of operations. Methods used for detecting WSDs, focusing on radio frequency (RF) detectors, spectrum analysis and nonlinear junction detectors (NLJDs), are also be discussed.

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1.INTRODUCTION

Wireless spy devices (WSDs) are surveillance equipment, such as listening bugs or cameras, hidden in objects or covertly placed in rooms. Surveillance using WSDs is one of the main methods of recording conversations for intelligence gathering as well as criminal charges. A Radio Frequency (RF) bug involves the placing of a radio transmitter in a room and listening within range using a receiver. One of the most infamous examples of the use of a RF bug is the “Great Seal Bug” story, when in 1952 a RF listening device was found in a carved wooden seal that had been presented to the US Embassy in Moscow and had hung in the Embassy since 1946. RF bugs can be incredibly small and can be concealed in just about anything including skirting boards, picture frames, plugs etc. Relatively inexpensive and easy to use, you need a receiver to listen to them. Radio frequencies are given off by nearly all spying devices, and these radio frequencies can be detected with specialist equipment as used by TSCM engineers. Different types of bugs give off a large range of frequencies and specialist equipment is required to check the entire RF spectrum. Basic RF detectors, that can be purchased relatively cheaply, will only be able to detect limited frequencies and will give you a false sense of security, and so its always best to engage the services of a professional TSCM provider.

2.LITERATURE SURVEY

German physicist Heinrich Hertz developed the first crude radio transmitters (also known ass park gap transmitters) in 1887 while conducting ground-breaking research on radio waves. Ahigh voltage spark between two conductors produced the radio waves. These transmitters were used by Guglielmo Marconi to create the first effective radio communication systems starting in1895, and radio started to be used commercially around 1900. The operator tapped a telegraph key to turn on and off the transmitter, which produced radio wave pulses that represented text messages in Morse code since audio (sound) could not be transmitted by spark transmitters. Instead, information was transmitted by radiotelegraphy. These pulses were audible in the receiver's loudspeaker as "beeps" and were converted back to text by an operator who understood Morse code. The wireless telegraphy or "spark" era, also known as the first three decades of radio (1887–1917), saw the use of these spark-gap transmitters. Spark transmitters were electrically "noisy" because they produced damped waves. They produced radio noise that interfered with other transmitters because they dispersed their energy over a wide range off requencies. In 1934, damped wave emissions were made illegal by international law. Practical Frequency Modulation (FM) transmission was invented by Edwin Armstrong in 1933, who showed that it was less vulnerable to noise and static than AM. The first FM radio station was licensed in 1937.

3.METHODOLOGY

The FM transmitter will be based on direct frequency modulation technique using a BC457 NPN transistor and some capacitors and resistors. The Transistor does the main work of creating modulated frequency of electric signal which is gained from electric mic as an analog signal. With the help of DC voltage source of high amount , it creates a signal of high frequency . In accordance of help, there are used of several pf and uf capacitors and resistors. Now if you do a quick little Google Search on to FM transmitter circuit You will get quite a lot of results and they work really good if you prototype onto your bread board but the biggest problem is the size no matter which design you choose size will be at least as big as Your Fm so it won't make your Bug Spy so i was searching FM transmitter on ebay and I found this very tiny land really interesting FM transmitter module this module has a built-in microphone and adjustable frequency Potentiometer so I decided to buy this and test whether it works. Take Your FM transmitter microphone circuit and hook up a 3.7 volt battery at its positive and negative terminals. Cheap alternative to the lipo battery can use Two 1.5v Button cells in series. Middle terminal of this board is your antenna now without antenna its range is very limited there is no antenna that is Ultra small and still do the job of increasing the range I found a solution to make a antenna by yourself. I used a conductive copper foil tape which can be sticked on to the back side of the battery in plus shaped like shown in the picture and after that solder to the middle terminal of FM transmitter board so there it is guy's your FM transmitter is ready now.

3.1BLOCK DIAGRAM

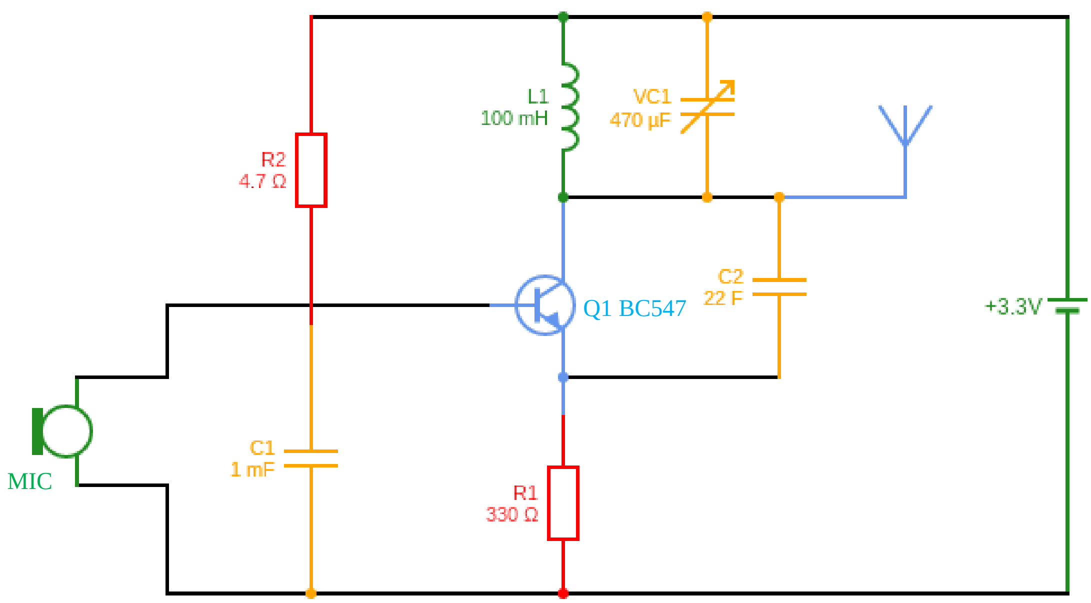

Fig. 3.1 Block Diagram of Proposed Method

4.TOOLS USED

HARDWARE REQUIREMENT

- Fm Transmission System
- Ceramic Capacitor
- Antenna
- Transistor
- Battery
- Resistor
- Fm Receiver

4.1 FM TRANSMISSION SYSTEM

A FM transmission system, primarily comprises 4 basic sub-sections:

- Microphone
- Audio Amplifier
- Modulator
- RF Oscillator

Microphone: A microphone is an input device that was developed by Emile Berliner in 1877.It is used to convert sound waves into electric waves or input the audio into computers. It captures audio by converting sound waves into an electrical signal, which may be a digital oranalog signal. This process can be implemented by a computer or other digital audio devices. The first electronic microphone was based on a liquid mechanism, which used a diaphragm that was connected to a current- charged needle in a diluted sulfuric acid solution. It was not able to reproduce the intelligible speech.

Audio Amplifier: Audio amplifiers are the basic power amplifiers that can be of various types like it is designed in various versions. There are various parameters technically and even the parameters related to infrastructure also affect the audio amplification. The audio amplifiers are designed in the form of chips and various sizes.

RF Oscillator: The function of the RF oscillator is to produce a high frequency signal in the FM range (88 – 108MHz), called a carrier wave. The carrier wave is a sinusoidal signal with constant amplitude and constant frequency. The frequency at which the FM transmitter operates is referred to as the carrier wave frequency.

Modulator: The modulator provides the means by which the electrical signal representation of the sound wave is embedded within the carrier wave. In frequency modulation (FM), this is achieved by varying the frequency of the carrier wave in relation with amplitude changes in the modulating signal (i.e. audio signal). The resultant is a modulated wave of high frequency that contains the audio signal. This is a very important part of a FM transmission system, because it allows the advantages of high frequency signal transmission to be exploited such as: I. Practical antenna length: The Length of the antenna is directly related to the wavelength of the wave; and the higher the frequency, the shorter the wavelength. Hence the smaller the antenna required. Higher Energy Transmission: The energy carried by a wave depends upon its frequency. The higher the frequency of the wave, the greater the energy possessed by it. As the audio signal frequencies are small, they cannot be transmitted over large distances if radiated directly into space.

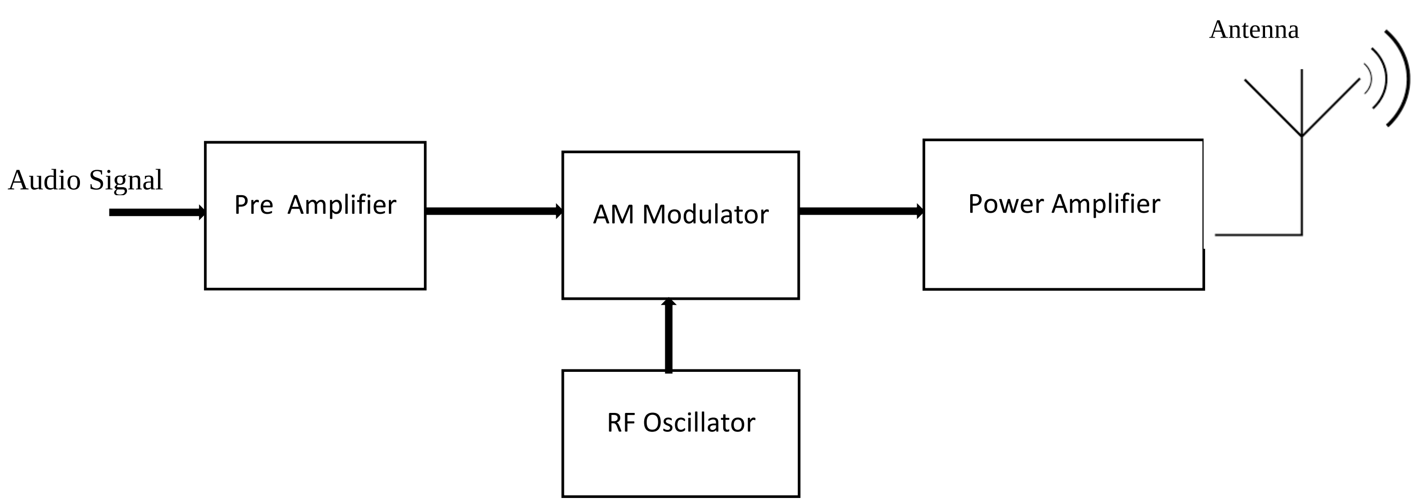

Fig. 4.1 Basic Block of a Fm Transmitter

4.2 CERAMIC CAPACITOR

A ceramic capacitor uses a ceramic material as the dielectric. Ceramics were one of the first materials to be used in the producion of capacitors, as it was a known insulator. Many geometries were used in ceramic capacitors, of which some, like ceramic tubular capacitors and barrier layer capacitors are obsolete today due to their size, parasitic effects or electrical characteristics. The types of ceramic capacitors most often used in modern electronics are the multi-layer ceramic capacitor, otherwise named ceramic multi-layer chip capacitor (MLCC) and the ceramic disc capacitor. MLCCs are the most produced capacitors with a quantity of approximately 1000 billion devices per year. They are made in SMD (surface-mounted) technology and are widely used due to their small size. Ceramic capacitors are usually made with very small capacitance values, typically between 1nF and 1µF, although values up to 100µF are possible. Ceramic capacitors are also very small in size and have a low maximum rated voltage. They are not polarized, which means that they may be safely connected to an AC source. Ceramic capacitors have a great frequency response due to low parasitic effects such as resistance or inductance.

Fig. 4.2 ceramic capacitor

4.3 ANTENNA

The range achieved from the system is dependant on the choice and position of the antenna. The space around the antenna is as important as the antenna itself. The optimum position is to locate the antenna so that is protrudes directly out the top of the transmitter box. If this is not possible due to other design constraints, try to keep the antenna away from other metal in the system such as transformers, batteries and PCB tracks, especially ground planes. In particular, the HOT' end of the antenna should be kept as far away as possible from these. For further information on Antenna design please see our full product catalogue which gives: recommended applications guidance. An antenna is a device that provides a transition between electric currents on a conductor and electromagnetic waves in space. A transmitting antenna transforms electric currents into radio waves and a receiving antenna transforms an electromagnetic field back into electric current.

4.4 TRANSISTOR

A transistor consists of two PN diodes connected back to back. It has three terminals namely emitter, base and collector. The basic idea behind a transistor is that it lets you control the flow of current through one channel by varying the intensity of a much smaller current that's flowing through a second channel. Basically, the transistors used for the wireless FM bug are Bipolar Junction Transistors (BJTs) and a type of the BJT which is NPN transistor.

BC547 NPN Transistor: The BC547 transistor is an NPN transistor. A transistor is nothing but the transfer of resistance which is used for amplifying the current. A small current of the base terminal of this transistor will control the large current of emitter and base terminals. The main function of this transistor is to amplify as well as switching purposes. The maximum gain current of this transistor is 800A.

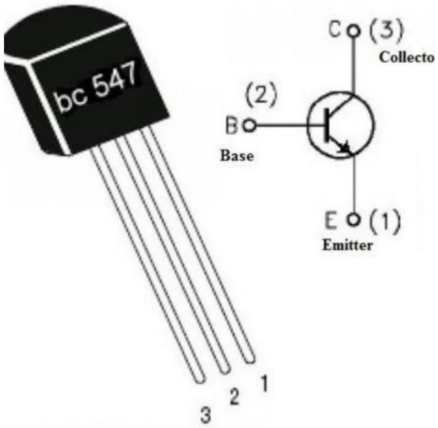

Fig. 4.4 BC547 Transistor

Pin1 (Collector): This pin is denoted with symbol ‘C’ and the flow of current will be through the collector terminal.

Pin2 (Base): This pin controls the transistor biasing.

Pin3 (Emitter): The current supplies out through emitter terminal.

4.5 BATTERY

The 3.3V lipo Battery were used for the power supply. Our rechargeable standard batteries are available off-the-shelf, without any development costs. This leads to reduced battery development efforts for mobile applications and enables much faster time-to-market .Naturally, our lithium-ion standard battery packs fulfil all the market-relevant safety standards as well as the worldwide national approvals. These aspects combined with the off-the-shelf availability reduce the overall development costs and allow your new device to reach profitability much earlier. We utilize lithium-ion cells with the highest energy density, maximized discharge current, and the utmost safety levels. The audio transmitter used here has a mic and 3 pins as seen in the above circuit. The Vcc and GND pins are connected to a 3.3V rechargeable battery that powers the transmitter module. The third pin is to connect the antenna for the transmitting range to be extended. Lithium Polymer Battery, popularly known as LiPo Battery, works on the lithium-ion technology instead of the normally used liquid electrolyte. These kinds of batteries are rechargeable thereby providing users with huge savings in terms of cost. The voltage of a single LiPo cell depends on its chemistry and varies from about 4.2 V (fully charged) to about 2.7–3.0 V (fully discharged), where the nominal voltage is 3.6 or 3.7 volts (about the middle value of highest and lowest value) for cells based on lithium-metal-oxides (such as $LiCoO_2$). This compares to 3.6–3.8 V (charged) to 1.8–2.0 V (discharged) for those based on lithium-iron-phosphate ($LiFePO_4$).The exact voltage ratings should be specified in product data sheets, with the understanding that the cells should be protected by an electronic circuit that won't allow them to overcharge nor over-discharge under use. LiPo battery packs, with cells connected in series and parallel, have separate pin-outs for every cell. A specialized charger may monitor the charge on a per-cell basis so that all cells are brought to the same state of charge (SOC).

Fig. 4.5 3.7v lipo battery

4.6 RESISTOR

A Resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity. Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

Fig. 4.6 Resistor

4.7 FM RECEIVER

The RDA5807M frequency modulation chip is as tiny as shown below. An ESP8266 12F chip is needed to drive it; as it works on I2C communication which is the same interface used with the ESP chip. This scans and matches the frequency of the receiver with the transmitted signal. Since the ESP8266 chip does not have USB ports, an FTDI module is needed to program it for communication. Using the USART serial port to drive the RDA5807M FM chip, we send the command to ESP which further sends the signal to the I2C port of the FM chip. To create the program, the radio library is used to drive the FM chip and to be used over I2C. The ESP board in the Arduino IDE needs to be installed, after which the library and programming of the ESP chip can be done. After installing the radio library in the Arduino IDE, Go to Examples and upload the scan code to the ESP chip. The ESP chip has to be set in the programming mode by connecting the GPIO 0 to GND and Vcc to 3V of the FTDI module. The GND to GND has to be connected along with the Tx pin to the Rx pin and vice versa before uploading the code.

Fig. 4.7 FM Receiver

5. RESULT AND DISCUSSION

First of all we need a NPN Transistor BC547. Then we add a 10pF capacitor with the emitter and collector pin of the transistor. Now we add one side of a 27k resistor with the base pin of transistor and a 10k resistor with the 27k resistor. Now 470ohm resistor will be connected with collector and 10k resistor. 103 pf capacitor will be connected on two sides of10k resistor. 104 capacitor will be connected with base pin on one side and on other side with another 10k resistor. And the other side of this 10k resistor will be connected with 27k resistor . Mic will be connected with the join of 104 and 10k and other side with the join of103 and 10k . Now the coil will be connected with emitter pin and positive reel . And a antenna can be connected with emitter or collector point. Now the power supply will be connected as the positive side on the emitter part and negative side on the collector part. The audio transmitter FM device is powered-on and hidden in the desired location. The ESP and FM radio receiver device are plugged and the serial port is opened. After scanning the range of FM channels, the channel for the right frequency is selected. In other words, this means, the FM channel of the audio bugging device is selected, and you can now hear what is being talked about at the place the transmitter is placed.

6. CONCLUSION

The Smallest FM Audio Bug Spy Device is an ideal device for any individual or organization that requires discreet and reliable surveillance. Its small size makes it easily concealable and it produces high-quality audio recordings that can be heard from a great distance. The device also features a long battery life and a range of additional features, such as adjustable transmit power, built-in microphone and adjustable sensitivity. With its ease of use and excellent performance, the Smallest FM Audio Bug Spy Device is sure to be a trusted and reliable addition to any surveillance setup. One well-known method of surveilling people is with microphone bugs. an apparatus that has recently been modernised with new technology. Nevertheless, the security sector despite the known cases of spied citizens, has a profound misunderstanding of how the technology operates and how to detect them. It is crucial to address this issue, and in order to do so, control over this technology was required. In order to learn the truth about the use of microphones for spying, we conducted a lot of experiments with real microphone bugs and developed our own SDR detection tool. According to our research, placing microphones is very challenging due to the need for a power supply, the nature of the microphones, and the challenge of listening.

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