

Electronic Pest Repellent: A Review

Dileep Kumar Tiwari

Department of Electronics and Communications
Jaipur National University
Jaipur, India
dil.371987@gmail.com

Mamta Alam Ansari

Department of Electronics and Communications
Jaipur National University
Jaipur, India

Abstract—So many remarkable things are happening in the world of science and technology but yet there is no effective solution to repel pests electronically. This review paper focus on the various pest controlling methods and also talks about the electronic pests controller based on frequency generation technique. The various pesticides, herbicides and other repellent are toxic and are risk for human health. Electronic Pest Repellent (EPR) is an emerging technology which is cheap, eco-friendly and effective and produces no risk at all to human. Electronic Pest Repellent is an electronic device that is capable of generating sound of ultrasonic frequency range, not audible to human ear but to pests like rodents, birds, insects etc. Because of the sound of this frequency (10 - 100 kHz) pests feel unpleasant and due to intense auditory stress they move away from the device. The device can be utilized by general public to repel mosquito, farmers to repel rodents, insects and other pests.

Keywords—Frequency repellent, pests, Electronic pest control.

I. INTRODUCTION

Today the most common method used for control of pest is the use of the pesticides. Chemical substance or the mixture of chemical substances used for killing, avoiding, repelling or mitigating pests are called pesticides. Pesticides are generally used in and around homes as they are easy to apply, act fast, and are highly effective for various pests. But it is important for general public to know the effectiveness and toxicity of these chemicals [5]. The researchers have found that chemical method of pest control is very effective but maintenance is quite expensive. Moreover these chemicals are highly toxic and act as a slow poison and harsh both to humans and wildlife [8]. Use of these chemical causes air pollution which is thought to be one of the most important risk factors for respiratory diseases, particularly for bronchial asthma and chronic obstructive pulmonary disease[3]. Also, it pollutes the soil, water and environment that it brings the genetic mutation to the pests that they produce offspring which becomes immune to these chemicals that were used on their predecessor [3]. The controlling of mosquitoes is also crucial as in the present day context as mosquito cause more suffering to human than any other organism with the rise in many mosquito borne illnesses like malaria, dengue, chikungunya, zika etc. People prefer mosquito coil and other chemical repeller smoke which are very dangerous and toxic than 100 of cigarettes smoked at a time. Other mosquito repellent are also applied to skin, clothes and any other surfaces to keep away mosquitoes. Similarly Insects, rodents and birds causes damage to sow seeds, as well

as seedlings, fruits and also flowers, it is estimated that 33 percent of the grown crops are consumed by pests in the United States. Globally 35% of the pests are consumed by these pests [8]. This coupled with society's growing concern about environmental risks, makes alternative methods of pest control increasingly attractive. Due to these harmful effects of pesticides to wildlife as well as humans, there is a growing demand for pesticide alternatives. The method that does not use harmful and poisonous synthetic chemical compounds to destroy or deter insects are called pesticides alternatives. Some of the few alternative method includes aromatic herbal compounds like citronella, hormone sprays, and electronic sound producing devices. After so many decades of technology still there is no efficient way, available in market to repel the pest. The audible frequency for human is 20 Hz to 20 kHz and sound above or below this frequency is not audible to human ear. Pests can detect and hear sound more than 20 kHz as well and feel irritated and unpleased which force them to leave and stay away from a certain boundary. This method of pests repelling can be done using an ultrasonic device which is the best alternative to chemical repeller method suppressing the toxic and adverse effect on health due to chemical repeller and pesticides. The device aims to repel small birds, mosquito, flies, moths, bats and other nocturnal insects, rodents, avian etc.

II. SALIENT FEATURE OF ELECTRONIC PEST REPELLENT

Electronic pest repellent has many advantages over a chemical repellent. Some of the salient features are as follows:

- **Power Efficient:** The device operates on a very small voltage equivalent to 5 volt and consumes less power and there is no need to modify the circuit for extra separate power supply.
- **Cost:** The cost of the electronic device is less low so that every individual and family can buy and use it.
- **Compactness:** The device uses few IC's and other electronic components and can be packed compactly so that its size becomes small and can be kept anywhere.
- **Power Indication:** An led on the device show the power indication which help the user to easily identify whether the device is working or not.
- **Simple and Elegant Circuit Design:** The circuit can be simply made so that mass production can be easily

done. Also in case of damage the device can be repaired easily.

- **No Harm and No Toxicity:** It doesn't produce any smoke, gases and radiation and even the sound is not audible to human ear. So it is totally harmless and produces no toxicity at all.

III. RELATED WORK

Ibrahim et al. [1] aims to replace the chemical method and use of bio pesticide method with ultrasonic pest repelling system and he targeted it for rodents and insects mostly. It is eco-friendly and alternative means to chemical pesticides that prevent soil and air pollution. According to him the polluted air and soil can cause human risk factors such as respiratory diseases related to asthma and chronic obstructive pulmonary disease (COPD). Chemicals brings about the genetic mutation of the internal make up of these pests that they produce off spring that are immune to these chemicals that were used on their earlier generation. The rodents have their audible frequency range from 1 Hz to 100 KHz. High frequency sound forces them to leave the particular area due to intense auditory stress. So as an alternative, the author used an ultrasonic device which comprises of the power unit - Battery or AC power of 12 volt DC, and then the pulse generator unit by which frequency of emission of ultrasonic sound was continuously varied. The frequency which is ≤ 150 Hz is generated through 555 Timer IC and then send to the CD4017 decade counter for the frequency division and then NPN and PNP transistor are used for the signal amplification. IC CA3130 (Audio Amplifier) is used to amplify this frequency and for transmission to the free space speaker is used.

The effectiveness of the device was increased by repeated and continuous varying of frequency of oscillation in order to prevent the pest from being habitual. Most of the bird activity takes place in early mornings therefore for testing morning time was selected. Similarly the device was tested on wheat pest. Apart from such indispensable consequences, the testing of the device was conducted on a trial and error basis as pests and insects move on continuously so it becomes difficult to adore them. Also the judgment of the performance is bit tedious, as there is no such criteria to judge repellence. The accuracy and working of the device has few limitations due to climatic conditions as distance covered by the ultrasonic sound is observed on Sunny, rainy and dull days. Due atmospheric factors like humidity, air velocity, temperature etc. the distance covered by sound get affected. The sound travels longer distances in rainy and also in mornings due relatively lower temperatures. The waves travel for long distances in moist air compared to dry air.

Authors [2] conclude "The world's most dangerous animal is the mosquito," according to a BBC World Service health program as they carry of many harmful diseases like Malaria, Dengue Fever, Chikungunya, Lyme disease etc. Chemical repellent are used generally to repel mosquito which has a remarkable safety profile, but they are toxic against the skin &

nervous system and also causes rashes, swelling, and eye irritation. It causes brain swelling in children, anaphylactic shock, and low blood pressure. Hence an alternative to the chemical mosquito repellents is to be found and preferred over chemical mosquito repellents. Author's case study the different repellent way that is available in market and their disadvantages that they are more expensive, and accuracy is less.

Author [3] focused on designing an ultrasonic pest repellent system which can be a very useful device to counter the various problems due to ants, insects, pests, rodents, etc. Due to the compactness, low cost and pollution free source unlike the other chemical repellents the device can be highly effective. They used an audio power amplifier that takes 1 V p-p square wave input generated from the microcontroller unit and gives an amplified signal to the speaker. The microcontroller unit can operate in various modes depending on user input Similarly 4x4 keypad was used to give various input depending upon environment condition and availability of pest and different modes can be selected by the user. A standard 16 pin LCD display was used to view the choice entered by the user mode selected in which the circuit was working. LM 380 audio power amplifier was used to generate frequency range around 80 kHz. To transmit these sound waves a speaker of appropriate frequency range is used. Microcontroller generates sweep in sound frequencies and tested experimentally on ants, bugs, and small insects, and found successful in repelling them by generation of such ultrasonic frequency.

Author [4] aimed to design a circuit using ultrasonic sensors that repelled insects using its frequency hearing range. The design was low cost portable sound frequency detector. This device can widely be used depending on situation and places. The project work on this says sound frequency was detected within the coverage area about 21mm to 37mm on a solid wall room. They develop a device can emit ultrasonic energy of varied frequencies which do not affect the hearing ability of man but affect the auditory senses of pests like rodents, avian and nocturnal insects by making them uncomfortable in their abode. Author used an Astable Multivibrator (AMV), timer NE555 to generate the required ultrasonic frequency and varied the frequency automatically in 5 steps by an IC called as pulse generating IC (CA3130) and a counter (CD4017). To obtain a signal of symmetrical output A D-type flip-flop IC (CD4013) was used which was amplified in push-pull mode by 2-NPN and 2-PNP transistors as BD-139 and BD140 respectively. Five 100k variable resistors were used to control the different frequencies selection. Two transducers were employed to produce an efficient sound generated. Author's fully tested device on three groups of white foot mice over a distance of 5, 10 and 15 meters. The mice were housed in cages in order to check their directional movement, to make food available and to make observation easy. The device was activated and simultaneously the reaction of each and every groups were observed. Again, the ability of the device was tested on a house mouse with a two day old litter of three. It was activated at a distance of 5 meters from the mouse and its

litter for 5 minutes after which it was deactivated. The performance and efficiency of the device could be greatly improved by modifications using microcontrollers or ultrasonic sensors to transmit the sound in a specified band of frequency. The device can be utilized by both farmers for the purpose of repelling pests but for home the amplification is not done as sound intensity may cause hearing impediment.

In paper [5] the electronic pest control device is a contribution of electronics engineers to agriculture. This reduces the loss to done by pest every year, encouraging the farmers to produce more food as farmer's income increases. Also it makes agriculture system attractive enhancing food efficiency. This non chemical pest control method have been alternatively advocated as the best and efficient way to reduce pesticide contamination in our environment as it is also pesticides-free alternatives to raising food. The author focused on the ultrasonic type of electronic pest control devices designed to emit ultrasound which is sound of frequency more than 20 kHz. Electronic oscillator for the production of frequency was used which required to repel pest. The function of an electronic oscillator is to repetitively generate electrical signal of a specific frequency. In this case, 20 kHz and above frequency of oscillation depends on the constants of the device like resistance, capacitance and inductance etc. Electronic pest control device comprising the oscillator, a small transistor amplifier and additional circuits like tripping circuits, sonic circuit, preamplifier, 555 timer, frequency selection circuit for varying frequency and other additional components making recent designs more effective. Electronic pest control devices emit ultrasound which goes beyond the threshold sound hearing capacity of targeted pests. The usual arguments by users are regarding its effectiveness. This controversy has constituted a huge challenge to the implementation of the device in the developing world as public don't accept it. More proactive researchers from a developing nation have recognized habituation as one reason behind the controversy and that delay of habituation by the introduction of variability will contribute to resolving the controversy. Design considerations and practices to technically fortify the device and aid in the delay of habituation were also proffered. This step will lead to the emergence of electronic pest control devices that can be used with less controversy

Author [6] used fluorescent lamp at night near bushes which attracted many insects in the dark. After that the ultrasonic pest repelling device was activated and on frequency generation the insects soon moved on and get repelled almost. Some of the insect moved away at certain constant frequency but other species of insect didn't move as repelling frequency was found different for different species of arthropods. Then he collected the data and calculated what extent the device is working and what can be its efficiency. He found the accuracy of the device as 75%.

Similarly other methods can also be used on field test like using the device around the field containing crops [7.] The device can be even tested on domestic birds like hen, ducks etc. The area that are mostly visited by rodents like squirrel should

be a place to place ultrasonic pest repelling device in order to test the working accuracy on squirrel.

Author [8] says insects respond to 2 – 100 kHz, can detect sounds from long distances (10 m or more) they need tympanic organs or eardrums (but not always). Thus the author concluded the ultrasonic range for detection is better than the location of crops if the device is kept at the boundary.

Author [9] advocated about agriculture saying it provides a good platform to eliminate poverty and unemployment in developing nations. The electronic pest control device is a contribution of electronics to agriculture as it reduces loss to pests, encourages farmers to produce more food, increases farmers income, makes agriculture desirable to the unemployed and thereby enhancing food sufficiency. If the challenges hampering the smooth implementation of the device are accepted and taken as a serious issue, the future is bright and healthy for developing nations.

Author [10] says Development of electronic circuit design in line with design consideration is the best and useful means instead of pesticides and herbicides. Such design will better adapt to the environment of developing countries. Laboratory and field testing of the designed and constructed device for proper performance and evaluation is required. With all these in place, developing countries will march better in the field of agricultural advancement because of electronic pest control devices now and in the future.

Author [11] also talks about a circuit of an electronic pest repeller. It is effective over a diameter around 16 meters. Wide varieties of electric mosquito repeller that are still not in practice so much are available in market. These basically consist of a small hot plate or a chemical mat in order to produce smokes and fumes. These fumes not only affect the mosquitoes and other insects but also adversely to human beings. Some of these devices are costly in operation as well. This circuit only uses ultrasonic waves rather than chemical fumes or harmful toxic smoke. This circuit generates an output from 30 to 50 kHz, which is not audible to us and hence is harmless to human beings. The CD4017 decade counter having ten outputs as a variable frequency and each output goes high one after another. The oscillator built using NE555 timer clocks this decade counter CD4017 which generates the frequency and gives the desired output.

Author [12] says the presence of pests in any food handling premises is undesired and unacceptable. The risks posed by pests include the spread of disease by pathogens which are transferred from the gut or any other external surface of the pest. This results in damage to property, contamination of work surfaces and foodstuffs. Sometimes it has an adverse effect on public opinion and results in loss of reputation, prosecution and closure even poor staff relations are noticed. The objective of the electronic pest control should be to prevent these activities, as far as practicable, reducing the introduction of pests on these areas and to minimize the conditions that may encourage their presence.

Author [13] talks about ultrasonic repellent or control devices and outdoor devices for electrocutting flying insects. But further he explains public don't trust it no matter how

effective a new product is, it cannot initially sell itself above the publicity accorded to it. Electronic pest control devices have yet not enjoyed wide popularity and publicity as public are still dependable on chemical methods. So such devices needs so much publicity and can be used as the best alternative to chemical pesticides.

IV. CONCLUSION AND FUTURE SCOPE

An extensive performance evaluation is required to determine the efficiency of the device on different pests. The performance of the device could be greatly improved with little modification. These devices also need so much publicity as it is mostly restricted and limited to promo pages and research papers on the internet and academic journals that does not command large viewership by public. As farmers feed the world, it is necessary to increase the crop production to a very high level and toxic free. The device can be utilized in agriculture by both small and large scale groups of farmers for the purpose of repelling pests. Saying goodbye to chemical method of pest control will be considered greater achievement now and in future.

The focus of further research and development is on how these ideas can be implemented to put forward an effective electronic design for electronic pest control devices capable and successful enough of surmounting the present challenge of pest infestation and also settling the controversies surrounding the efficacy of such applications.

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