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Intelligent e- Pest Repellent System

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ABSTRACT
There are many remarkable things happening in the world of science and technology, but yet there is no effective solution to repel pests healthy and chemical free. This paper focuses on various pest controlling methods and also talks about the e- pests controller based on variable frequency generation technique. The purpose of the project is to design an e- pest repellent. Such a device can be very useful to counter the various problems caused by ants, insects, pests and rodents The device is compact, cheap and it does not cause any pollution unlike the other chemical repellents. We have used a microcontroller to generate sweep in sound frequencies and an assembly consisting of audio amplifier, LCD. The e-pest repellent is made intelligent using ANN.

Keywords – Frequency repellent, rodents, pests, chemical free pest repellent.

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I. INTRODUCTION

The pests are insects that travel in large swarms that can travel up to 150 kilometers in a day depending on the wind speed. They devastate crops and cause major agricultural damage, which can lead to famine and starvation. There are more than 500 species of acridids (Orthoptera: Acridoidea) that can cause damage to pastures and crops [1], and about 50 are considered major pests. Since the beginning of civilization, locusts and grasshoppers have been among the most devastating threats to agriculture. This group of insects contains hundreds of pest species and affects the livelihoods of one in every ten people worldwide [2]. 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. It is possible that pests like insects, ants, rats, mice etc. are repelled by frequency in the range of 30 kHz to 50 kHz. Human beings can't hear these high-frequency sounds. Our product repels pests by emitting pulse waves. Using audio amplifier, waves creates a noisy and hostile environment which repels pests, whilst remaining absolutely safe for humans and household animals. Unfortunately, all pests do not react at the same frequency. While some pests get repelled at 35 kHz, mosquitoes, fleas, house fly, spiders get repelled at 38 to 44 kHz and rodents respond to frequency around 60Hz. Thus, to increase the effectiveness, frequency has to be continuously varied between certain limits. Frequency of emission of sound is varied by the device developed in this work in different patterns to repel different insects. 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 repellent method suppressing the toxic and adverse effect on health due to chemical repellent and pesticides. The device aims to repel small birds, mosquito, flies, moths, bats and other nocturnal insects, rodents, avian etc.

II. CHARACTERSTICS 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 at 5 volts and consumes low power 5-15 W. Solar PV generated power can be used for the power supply.

• Cost: It is a low cost of the electronic that every farmer can afford 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: A led on the device shows 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 or chemical effect. Even the sound is not audible to human ear. So it is totally harmless.

III. PROBLEM FORMULATION

Pest damage is a major limiting factor for global food production. Animal pests destroy 8–15% of global wheat, rice, maize, potato, soybean, and cotton production (Oerke, 2005) and cause more than US$30 billion damage in the United States each year (Pimentel et al., 2005). According to a study by the Associated Chambers of Commerce and Industry of India, annual crop losses due to pests and diseases amount to Rs.50,000 crore ($500 billion), which is significant in a country where at least 200 million Indians go to bed hungry every night. The value of plant science is therefore huge.

The largest recent grasshopper and locust outbreaks from 2003 to 2005 (13million ha, US $500million), large outbreaks of *Chortoicetes Terminifera* in eastern Australia in 2010 (1.1 million ha, US $50 million) and in Wyoming (2.4 million ha, US $7.4 million and 2013 to 2016 (2.3 million ha, US $37 million).There were also large-scale infestations in Eurasia of the Italian locust *Calliptamusitalicus*in 2000 (Kazakhstan; 8.1 million ha, US$23 million) and of the Italian locust with some Moroccan locusts, *Dociostaurusmoroccanus*, in 2014 (the Caucasus and central Asia; 6.7 million ha) [3].

It was estimated that the 1984 plague of the Australian plaque locust, of *Chortoicetes Terminifera* , would have caused US$84 million damage if it had not been controlled [4]. In North America, ever year, grasshoppers destroy 21-23% of rangeland vegetation, causing US $1.25 billion in monetary losses. Brader et al. [5] reported that, in Africa in 2004, the desert locust caused crop losses of >80% in Burkina Faso, Mali and Mauritania, with 8 million people affected and many households requiring food aid. Losses to crops and pastures are much disrupted and lead to further affects such as having to sell animals at low prices to meet the subsistence needs of households. Furthermore, the negative income shock may have a long term impact on systems[6, 11-14].

IV. NEED ANALYSIS

Ibrahim et al. [7] 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. Authors [8] concluded that "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.

In paper [9] 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. 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.

An electronic pest repellent is prudent alternative for chemical pesticides. These are electronic devices that generate either electromagnetic or ultra sound waves to repel insects and pests. Various studies show that these devices are indeed effective in repelling and eliminating a number of pests. Author [10] 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 and AI is used to control the frequency.

Imagining the quantity of chemical pesticides used by farmers, gardeners and households and the amount of environmental degradation caused by them is stressing and arouses concern. With farmers being aware and enthusiastic to take plant protection measures, replacing chemical pesticides with electronic pest repellents can be an effective pest surveillance service and a major sustainable agricultural approach.

V. DESIGN APPROACH

A LM 380 used for audio power amplifier circuit to design the system capable of producing sound in the frequency range of 75 kHz. An appropriate frequency range speaker is used to transmit these sound waves. A separate PV solar power module is used to give power to the system.

Atmega–16 microcontroller is used to produce the different patterns of frequencies which we require and a LCD – keyboard assembly to track and control this process. The Atmega-16 microcontroller is programmed so that it generates different patterns of frequency in different modes. A keyboard is also provided in the system, so that any of these different modes can be selected by the user. The block diagram of e-pest repellent is shown in Fig. 1. The hardware implementation is shown in Fig. 2.

VI. PARTS & SPECIFICATION

1. Arduino UNO
2. Buzzer, LCD
3. LM358 Op amp
4. Electrolytic Capacitor: 25V, 1000uF
5. Resistance 1K, 10K
6. DC Socket
7. AT mega 328 P
8. LM 7805
9. Header pins
10. Jumber wires, header wires
11. 1K POT
12. A Capacitor of 100uF
13. Battery 12V.

VII. INTELLIGENT E-PEST REPELLENT SYSTEM

The e-pest repellent is made intelligent with the help of artificial neural network (ANN) as shown in Fig. 3. ANN is trained for the data collected from literature to repel different types of pests. ANN output is the signal amplitude, frequency, and duration to repel the pests. It is very effective as compared to the simple e-pest repellent.

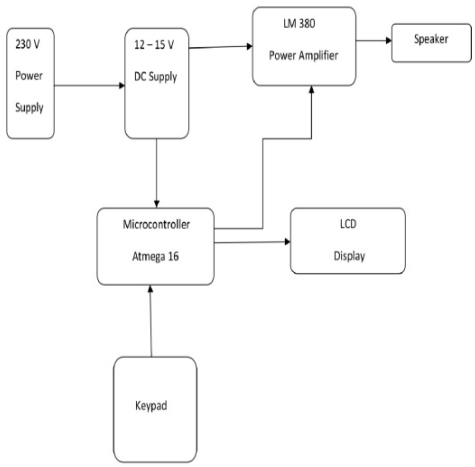

Fig. 1 Block diagram of e-pest repellent system

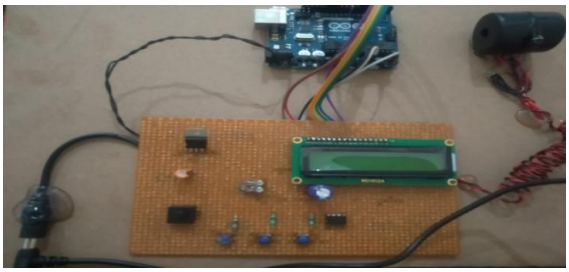

Fig. 2 Experimental set up of e-pest repellent system

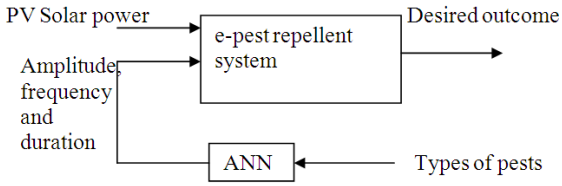

Fig. 3 AI based e-pest repellent

VIII. CONCLUSION

As farmers feed the world, it is necessary to increase the crop production to a very high level and toxic free. The paper deals with the design and development of e-pest repellent system for protecting the crops of farmers. An extensive performance evaluation of e-pest repellent is done to determine the efficiency of the device on different pests and ANN is trained. The trained ANN is used for developing intelligent e-pest repellent system. 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. 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..

REFERENCES

[1]. Centre Overseas Pest Res. 1982. The Locust and Grasshopper Agricultural Manual. London: Centre Overseas Pest Res.

[2]. Latchininsky AV, Sword G, Sergeev M, Cigliano MM, Lecoq M. 2011. Locusts and grasshoppers: behavior, ecology, and biogeography. Psyche 2011:578327.

[3]. Annual Review of Entomology-Locust and Grasshopper ManagementLong Zhang, Michel Lechoq, AlexandreLatchininsky and David Hunter

[4]. Wright DE. 1986. Economic assessment of actual and potential damage to crops caused by the 1984 locust plague in south-eastern Australia. F. Environ. Manag. 23:293-308

[5]. Brader L, Djibo H, Faye FG, Ghaout S, Lazar M, et al.2006. Towards a more effective response to desert locusts and their impacts on food security, livelihoods and poverty: multilateral evaluation of the 2003-2005 Desert Locust campaign.

[6]. DeVreyer P, Guilbert N, Mesple-Sompsa S.2014.Impact of natural disasters on educational outcomes: evidence from the 1987-89 locust plague in Mali.F. Afr. Econ. 24:57-100

[7]. Ibrahim A.G., Oyedum, O.D., Awojoyogbe, O.B., Okeke, "Electronic Pest Control Devices: A Review of their Necessity, Controversies and a submission of Design Considerations" S.S.N. Department of Physics, Federal University of Technology, Minna, Nigeria. The International Journal Of Engineering And Science (IJES), VOL.2 pp. 2319 – 1805, 2013

[8]. Enayati A, Hemingway J, Garner, "Electronic mosquito repellents for preventing mosquito bites and malaria infection (Review)", The Cochrane Collaboration. Published by John Wiley & Sons, Ltd, 2010.

[9]. Jeong-Kyu Kim, Chang-Soo Kang, Jong-Kwon Lee, Young-Ran Kim and Hye-Yun Han., "Evaluation of Repellency Effect of Two Natural Aroma Mosquito Repellent Compounds", Citronella and Citronellal, Entomological Research. vol.35(2), pp.117–120, 2005.

[10]. A. Brouwer, M.P. Longnecker, L.S. Birnbaum, J. Cogliano, P. Kostyniak, J. Moore, S. Schantz and G. Winneke, "Characterization of Potential Endocrine Related Health Effects at Lowdose Levels of Exposure to PCBs. Environ Health Prospect". 107, 1999

[11]. Cressman K. 2016. Desert locust. In Biological and Environmental Hazards, Risks, and Disasters, ed. R Sivanpillai, pp. 87–105. Amsterdam, Neth.: Elsevier

[12]. Buhl J, Sword GA, Simpson SJ. 2012. Using field data to test locust migratory band collective movement models. Interface Focus 2:757–63

[13]. Ke Xing & Xiao Zhu & Xue Peng & Sheng Qin, Chitosan antimicrobial and eliciting properties for pest control in agriculture: a review, Agron. Sustain. Dev. (2015) 35:569–588.

[14]. Gonzalez-de-Santos, P., Ribeiro, A., Fernandez-Quintanilla, C. et al. Fleets of robots for environmentally-safe pest control in agriculture. Precision Agric 18, 574–614 (2017). https://doi.org/10.1007/s11119-016-9476-3

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