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Effective Coverage Area Enhancement of a Pest Specific Ultrasound Pest Control Device through Ultrasound Booster Design

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ABSTRACT
One of the drawbacks of ultrasound pest control devices is in terms of their reach, as ultrasound is easily attenuated by intervening media. Ultrasound booster was conceived as a way out of this quagmire. In this work, an ultrasound booster was designed to increase the effective area of coverage of an existing stand-alone ultrasound pest control device designed to deter weaver bird away from farms. It is a five segment device, each consisting of a preamplifier, power amplifier and an ultrasonic transducer section. It receives raw ultrasound signal generated by the stand-alone device as input, process it and transmit it via its entire segment, resulting in a 360o horizontal spread and a bottom boost. Analysis of the designed and constructed booster system reveals that it enhanced the effective coverage area of the stand-alone device by a factor of five and nine when in isolated and contact placement methods respectively

Keywords: *Ultrasound, booster system design, stand-alone unit, booster unit, pest, weaver birds.*

1 INTRODUCTION

Ultrasound refers to sound frequency above 120 kHz (Novelline, 1997). It has a character of being inaudible to human ear but can be audible to certain animals such as bat, birds, insect and rodents (Cancel, 1998, Jones and Waters, 2000, Mann, 2001). When ultrasound is generated in an environment, such animals keep away from the vicinity (Brouwer et al., 1999). This idea has been applied in pest control with some level of success (Hangiandreou, 2003). In a previous work, an ultrasound pest control device was designed to improve the effectiveness of this method (Ibrahim et al., 2013a). The said device was pest specific and environmental specific in the sense that, it targets only weaver birds in an endemic area of North central Nigeria (Ibrahim *et al.*, 2016 and Ibrahim *et al.*, 2017). Upon implementation and testing, it generates and transmit ultrasound of specific frequencies (25 kHz and 35 kHz) identified to be effective in repelling weaver birds (Ibrahim, 2015). In addition, the device when instructed is able to broadcast audio sounds of identified weaver birds predators through a mega phone in order to fortify it against habituation. However, one of the challenges encountered when the stand-alone device was deployed was in terms of its reach, as pests keep away from crops closer to the device and feeds on distant crops. The reason for this observation is because ultrasound is a short ranger (Berke, 2002), as ultrasound is easily attenuated by intervening media. As a way out of this quagmire, ultrasound booster was conceived. An ultrasound pest control booster is a device that is used to improve the signal strength of an electronically generated ultrasound for the purpose of pest control (Ibrahim, 2015). In this design concept, raw ultrasonic signal is transferred from an ultrasound generator to remote stations, here referred to as booster locations where it is processes and transmitted within the locations with a 360o horizontal spread and a bottom boost. The aim of this work is to enhance the area of coverage of the stand-alone ultrasound pest control device through appropriate booster design and to determine the degree of success of such design.

2 METHODOLOGY

2.1 DESIGN DESCRIPTION

In this work, the entire ultrasound pest control system consists of two sub devices namely: the stand-alone unit and the booster unit. Each unit is made up of the device itself and other supporting parts working together to achieve same objective. The block diagram of the design connection between the stand-alone unit and its booster unit is shown in Figure 1.

The stand-alone device is capable of independently generating its power and ultrasound requirements, selects a portion of the ultrasound signal for amplification and transmission in order to deter weaver bids away from the area of coverage. The booster device functions along with the stand-alone device from where it derives its electric power and ultrasound signal. It receives raw ultrasound signal from the stand-alone device, amplifies and transmits it in their booster location. The idea behind the booster device is to increase the area of coverage of the stand-alone device. The constituent section of the booster device is shown by the thick solid block line on the right hand side of Figure 1. While that of the stand-alone device is shown by the thick dash line on the left-hand side of Figure 1. The ultrasonic signal relay line showing electronic signal communication between both devices is shown by the faint and directed dash lines while the power line is shown by the slime continuous lines. The concern here is not on the stand-alone, but on booster unit. However, due to the interdependence between both