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Smart Camera Traps

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***Abstract*— Normally camera traps are the typically devices that are used in the filed for the study of wildlife species in deep and remote forests but here using the basic idea of camera trapping ,we are trying to reduce the damage or reduce the man animal conflict, that is coming up theses everywhere on a massive scale, that is we are using the principles of bioacoustics to reduce the problems or damages caused by wild animals to the farmers, hence considering this fact that since humans, day by day have encroached into the forest and thereby since there is a reduction in green cover which in turn reflects in the migration and transit pattern of animals thereby animals land up in human habitation . Hence we make use of high frequency and high intensity sound waves to drive away the animals that cause harm or loss, along with image processing so as to identify the particular animal and emit those particular frequencies which are most sensitive to that particular animal and hence there by cause a neurophysiological effect such that a particular animal will get affected and go away from the site where it is causing damage.**

***Index Terms*—Camera trap, high intensity, high frequency, image processing**

I. INTRODUCTION

Bioacoustics is basically the science that deals with biology and acoustic together that is related to the production, perception and effects of sound on animals or mammals. This involves neurophysiological and anatomical basis of sound production, detection and relation of acoustics signals to the medium they disperse through. That is like the way how humans respond to different types of sounds, similarly all the animals and other living creature respond to a certain sounds and accordingly they either attract towards the sound or try to repel away from the sound due to varied reasons. Taking advantage of this facts various studies and researches have been made for various methods like to estimate, to photograph, to attract an animal or to shook it away. In this paper, we try to make a device, which would be having a camera so as to detect the animal within the viewing range of camera and accordingly to transmit the sound wave of required frequency and intensity to drive away the animals from approaching the device which would be ideally installed at a point where entry or movement of animal would restricted. This would prove very much useful for farmers as the movement of wild animals is causing damage to their crops, for houses and building in cities especially where monkeys are causing menance by damaging various things and also posing a threat to humans by attacking.

As all of us know that we humans have a hearing range of about 20 Hz- 20 KHz. But in real life it much varied that is every person to person hearing will be different. Also the above mentioned range is not precise it varies practically on both upper and lower sides. Similarly each and every animal has its own hearing range hence every species is sensitive to only a certain range of Frequencies. Also along with frequency we need to notice the intensity of sound. Every animal is sensitive to only a certain range of frequencies that is most sensitive range. The way we hear the sound varies that is the faintest level of sound that we can hear is about at an intensity of 0 dB to the sound that can damage our ear about 140 db. But in between this range of frequencies and intensities only at certain range of frequency is the most sensitive to human ears. That is about 1 KHz – 4 KHz, remaining range is not much within the highly sensitive area of ear.

Similarly in the sensitive frequency range even the sound with slightest intensity can be detected. Also if the intensity of sound is increased very much than also it is possible to hear the sound of high intensity. Now as mentioned earlier the at low intensity the threshold of hearing is at about 0dB producing an intensity of 1*10-12 W/m2 whereas at about 130 dB producing an intensity of 1*101 W/m2 that is giving rise to pain in ears. Now sound in the sensitive range and at high intensity makes it irritating for any animal therefore they won't enter that certain area or the point from where the irritating sound is being produced.

The below graph shows the various range of sound that is from threshold of hearing to threshold of pain. Also in the graph conversation range, music hearing range etc is shown. In the sensitive range of hearing at an intensity of about 130 dB is the pain area as shown in the

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graph, which is our point of interest. As within this area we intend to work and get the desired output such that the animals get scared or irritated and hence go away from the source of sound

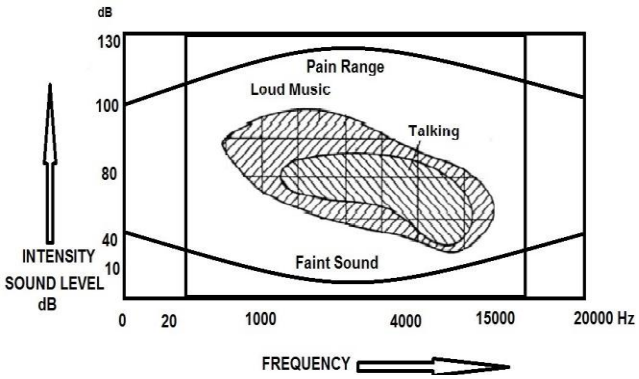

Fig 1:Hearing range of Human ear and various effects in different ranges.

II. DEVICE CONSTRUCTION

The design of the device would be in the following phases that is initially the main function would be in creating multiple frequency generator that is the generation of high intensity sound waves. In Second phase it would be in making it automatic that is camera would require and image processing be included so as to take up the image that is being generated by the camera and to process it that and generate the required output.

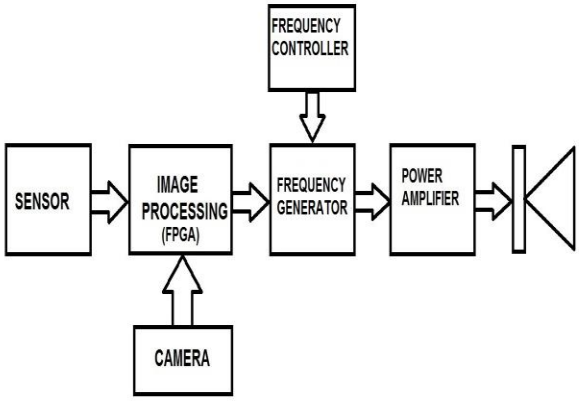

Fig2: Block Diagram of device

The camera as shown in the block diagram Figure 2, would be installed at such a location that there maximum chances of animal approaching in that particular path. Once movement or entry of animal into its viewing range, the camera will capture it and this image will now be processed.

During image processing, the databases will be stored in the memory of FPGA for which a dictionary would be built wherein the images would be stored, which would act as the reference image, now during the working the captured image would be tried to match with the database image and hence it would identify the most precisely, which animal is present in front of camera, now this output of image processing would be fed as an input to the Frequency controller. Now the frequency controller as per detected animal would produce frequencies in those ranges that are within sensitive hearing range of that particular animal. Now this sound wave will be having a comparatively low intensity as they are produce by low powered boards. This output will further go to power amplifier where in it will amplified to a quite a high level so as on to take it a large intensity, further its impedance is matched and is connected to a piezo or speaker so to transmit the required output.

The image processing would be done by using SIFT (Scale Invariant Feature Transform) descriptors that is image would be recognized with all local features such that it would be helpful to recognize almost any animal.

III. PRIMARY HARDWARE

1) Frequency Generator

The frequency would be generated using ICL 8038, as the basic frequency generator which along with simple assembly of capacitor and resistor network would be able to generate sine waves in different ranges with a wide and stable output.

2) Frequency Controller

Controlling of frequency, can be achieved by forming a large combination of R2R ladder network along with 8051 microcontroller which would help to generate frequency in a given range in form of incrementing and decrementing form in a stepwise manner that is, it would generate frequency in the in the most sensitive range and thereby would be most affecting the animal by switching between lowest to peak point of the hearing range.

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3) IMAGE PROCESSING

The Image that is stored in memory, would be like dictionary image, which would be referred during operation of device to compare a particular image with the dictionary image. The SIFT scale Invariant Feature Transform, algorithm would help to describe the image in detail as to with respect to the features and types of animals. The preferred hardware would be Digilent NEXYS4 DDR, as to it is having better capabilities to perform image processing.The Artix-7 FPGA is optimized for high-performance logic, and offers more capacity, higher performance, and more resources than earlier designs. With its large, high-capacity FPGA (Xilinx part number XC7A100T-1CSG324C) and collection of USB, Ethernet, and other ports, the Nexys 4 DDR can host designs ranging from introductory combinational circuits to powerful embedded processors. Several built-in peripherals, including an accelerometer, a temperature sensor, MEMs digital microphone, speaker amplifier, and plenty of I/O devices allow the Nexys 4 DDR to be used for a wide range of designs without needing any other components.

4) Power Amplifier

The output of the device would be much lesser, hence in order to achieve high intensity sound we need to boost the signal by increasing its intensity before it is fed to speaker or piezo. Also output should be emitted by an aluminum piezo or horn tweeter as it would be able to produce a high frequency and high intensity sound waves without much distortion or noise.

IV. SOFTWARE

Vivado

Vivado Design Suite is a software suite produced by Xilinx for synthesis and analysis of HDL designs, superseding Xilinx ISE with additional features for system on a chip development and high-level synthesis. Vivado represents a ground-up rewrite and re-thinking of the entire design flow. Vivado is a design environment for FPGA products from Xilinx, and is tightly-coupled to the architecture of such chips, and cannot be used with FPGA products from other vendors. Also Keil uVision4 IDE and Nuvoton ISP-ICP utility, v7.10 were used to feed program in the frequency controller and generator.

V. APPLICATION

As mentioned earlier this device, as a standalone device would be great importance to farmers and farmhouses.
Also to solve issue to man animal conflict, which is increasing, it would be best as it is a non-detrimental way of driving away wild animals without any injury or harm to the animals. Also now a days with growing railway network we see an increase in the deaths of wild animals due to collision of animals with railways, in this scenario it can prove very useful thereby help to protect our wildlife which is an important wealth and pride of our nation

VI. CONCLUSION

The Devices needs to placed such that there has to be slight or preliminary study of animal harm or damage since we are emitting very high frequency and intensity sound waves it is highly directional and changes with inverse square relationship hence we need to keep this mind before is placed on site. Also With respect to automatic identification of animals we need to see that closer the animals to the camera more will be similarities and hence easy for image processing or identify the animal. Also we need to have a huge database and images in various positions and angles of all possible pests such that they are easily identified.

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TianjiangWang1andThomasHuang2Linear Spatia lPyramid Matching Using Sparse Coding for Image Classification Jianchao Yang†, Kai Yu‡, Yihong Gong‡, Thomas Huang† †Beckman Institute, University of Illinois at Urbana-Champaign ‡NEC Laboratories America, Cupertino, CA 95014, USA