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Solar Powered Smart Ultrasonic Insect Repellent with DTMF and Manual Control for Agriculture

Prahlada Reddy[1], Pavan Kumar[2], Amruth Raju[3], Divya Rajan[4]
[1]*Electronics and Communication, New Horizon College of Engineering, Bangalore, India,*
[2]*Electronics and Communication, New Horizon College of Engineering, Bangalore, India,*
[3]*Electronics and communication, New Horizon College of Engineering, Bangalore, India,*
[4]*Electronics and Communication, New Horizon College of Engineering, Bangalore, India,*

Abstract: ***The purpose of this project is to design and development of an ultrasonic pest repellent. Such a device can be very useful to resolve the various problems caused by ants, insects, pests, rodents, etc. 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 power amplifier, speaker and LCD for this purpose. The technical details of this project follow later. The circuit has been experimentally tested on ants, bugs, and small insects, and it has been successful in repelling them through the generation of ultrasonic frequency sound.***
Keywords: DTMF, Arduino, Ultrasonic Frequency generation, Solar power, LDR.

I. INTRODUCTION

Human, animal or anything can produce sound. This sound is creating by the insect during their movement or anything. Insect can be defined as any of numerous small invertebrate (without a backbone) animals (as centipedes or spiders) that are more or less obviously segmented.

There are many approaches to controlling insects populations, including chemical pesticide control, insect-repelling plants and insect traps. Electronic pest control devices also provide a convenient means for controlling insects in or near your home.

Ultrasonic is a term for the audio frequency range that is too high--more than 20,000 hertz--to be perceived by the human ear, but it can be perceived by insects and animals.

Devices that emit ultrasonic sounds have long been used as a way to control misbehaving dogs, repel deer and to discourage insect proliferation. People seek to repel insects through machines that emit high frequencies. The idea is that the ultrasonic sounds bother insects and they will fly away from it.

However, scientific studies repeatedly have questioned whether such devices are effective. Machines that emit ultrasonic sounds produce noises so high-pitched that they are undetectable to the human ear.

Proponents of machines claim that the devices do several things to repel insects. First, the machines mimic predators, which scare away insects. High-frequency sound machine manufacturers claim that the frequencies prompt insects to leave the area immediately without harming or inconveniencing humans in the process

II. METHODOLOGY

A. The developed model device consists of three units as illustrated in fig 1. Which are as follows:

1) Ultrasonic frequency generation unit,
2) Solar charging unit and Controlling unit
3) Ultrasonic frequency generation unit is able to generate fixed and variable range of frequency according to the user's choice. A rechargeable DC battery along with a solar panel and solar charge controller circuit is employed to make a solar charging unit. The controlling unit consists of three types of control system. They are
4) Control from any distance using DTMF technology,
5) Automatic night mode using LDR and Manual Control Unit. The device has five modes. First three models are able to generate different frequencies ranging from 20 KHz to 100 KHz. The other two modes are combination modes and night mode.

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III. DESIGN AND DEVELOPMENT

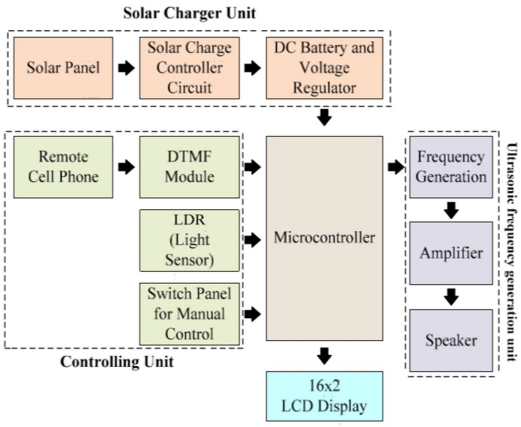

Figure 1- Block Diagram

A. *Hardware Components*

1) *Arduino:* Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.
2) *Bridge and Power Supply:* Semiconductor diodes are active devices which are extremely important for various electrical and electronic circuits. Diodes are active non-linear circuit elements with non-linear voltage-current characteristics. Diodes are used in a wide variety of applications in communication systems (limiters, gates, clippers, mixers), computers (clamps, clippers, logic gates), radar circuits (phase detectors, gain-control circuits, power detectors, parameter amplifiers), radios (mixers, automatic gain control circuits, message detectors), and television (clamps, limiters, phase detectors, etc). The ability of diodes to allow the flow of current in only one direction is commonly exploited in these applications. Another common application of diodes is in rectifiers for power supplies.
3) *LDR Sensor:* Light Dependent Resistors (LDR) are also called photoresistors. They are made of high resistance semiconductor material. When light hits the device, the photons give electrons energy. This makes them jump into the conductive band and thereby conduct electricity. It works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity (Hence resistivity) reduces when light is absorbed by the material.
4) *Solar Panel :* Since a solar cell is the only generator in a solar PV system, it is one of the most important parts in a solar PV system. A solar cell is a solid-state electrical device (p-n junction) that converts the energy of light directly into electricity (DC) using the photovoltaic effect. The process of conversion first requires a material which absorbs the solar energy (photon), and then raises an electron to a higher energy state, and then the flow of this high-energy electron to an external circuit. Silicon is one such material that uses such process. Generation of current in a solar cell is called light generated current and it involves absorption of incident photons to create electron-hole pair and collection of these carriers by the p-n junction.

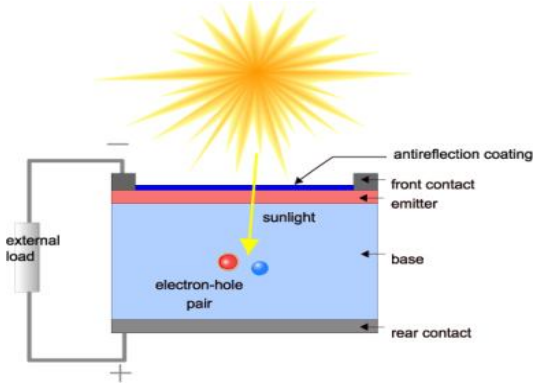

Figure 2- Solar Cell Structure

5) *LCD 16×2 Display:* LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments),animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

6) *DTMF Technology:* Dual Tone Multi Frequency, or DTMF as it is popularly known, is the technical term for the sound Frequencies produced when a telephonic key is pressed. DTMF also known as touch tone was primarily used for telephone signalling to and from the local exchange, though today it finds several applications in the field of telecommunications and call centers. A different frequency is assigned to each key in the telephone and there are two tones – one low frequency and another high frequency – that are played simultaneously when a key is pressed. This combination of two tones makes it nearly impossible to reproduce by the human voice. Each of the four rows of keys in a telephone is assigned a low frequency tone and each of the three columns is assigned a high frequency tone. A fourth column of keys labelled as A, B, C, and D is optional and is mostly used in military networks.

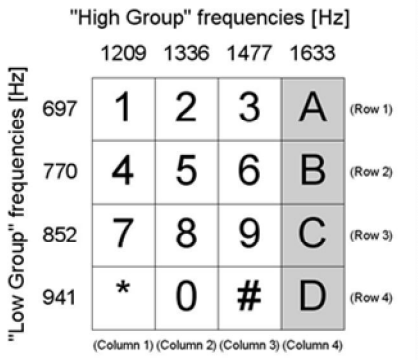

Figure 3- DTMF Frequency

There are sixteen DTMF signals, each of which is made up of two tones from eight different frequency signals. Twelve of these are commonly used by consumers with four being reserved for military use or use by exchanges. The keys A, B, C, D are usually absent from telephone sets used in homes and offices. These keys are system tones used for configuring telephone exchanges and to carry out special functions. The DTMF keypad for consumer use is designed in a four-row by three column matrix. Each dial row is represented by a low tone frequency and each column by a high tone frequency. The frequencies used are 697 Hz, 770 Hz, 852 Hz, 941 Hz, 1209 Hz, 1336 Hz, 1477Hz, and 1633 Hz.

IV. CONCLUSION

The proposed device model has been implemented for the agricultural system of Bangladesh but at the same time, this can be suitable for other domestic purposes. Farmers can keep the device either in auto mode or manual mode according to their necessity. Considering the economic and environmental impact of conventional chemical pesticides, this ultrasonic sound based technology is far better. Conventional noise system and chemical pesticides bring sound and air pollution respectively which is harmful to human body. The smart ultrasonic sound repellent device won't create such type of pollution. Besides, it is environment friendly as its charging system is fully depended on a solar panel. However, better performance can be obtained with high efficient solar panel i.e. thin film solar panels which have low weight compared to the conventional silicon solar panel. And this will reduce the overall weight of the apparatus. Although this study evaluates the effects of ultrasound waves against pests and bugs further studies of ultrasonic waves as an effective medium of controlling pest behavior are also still open.

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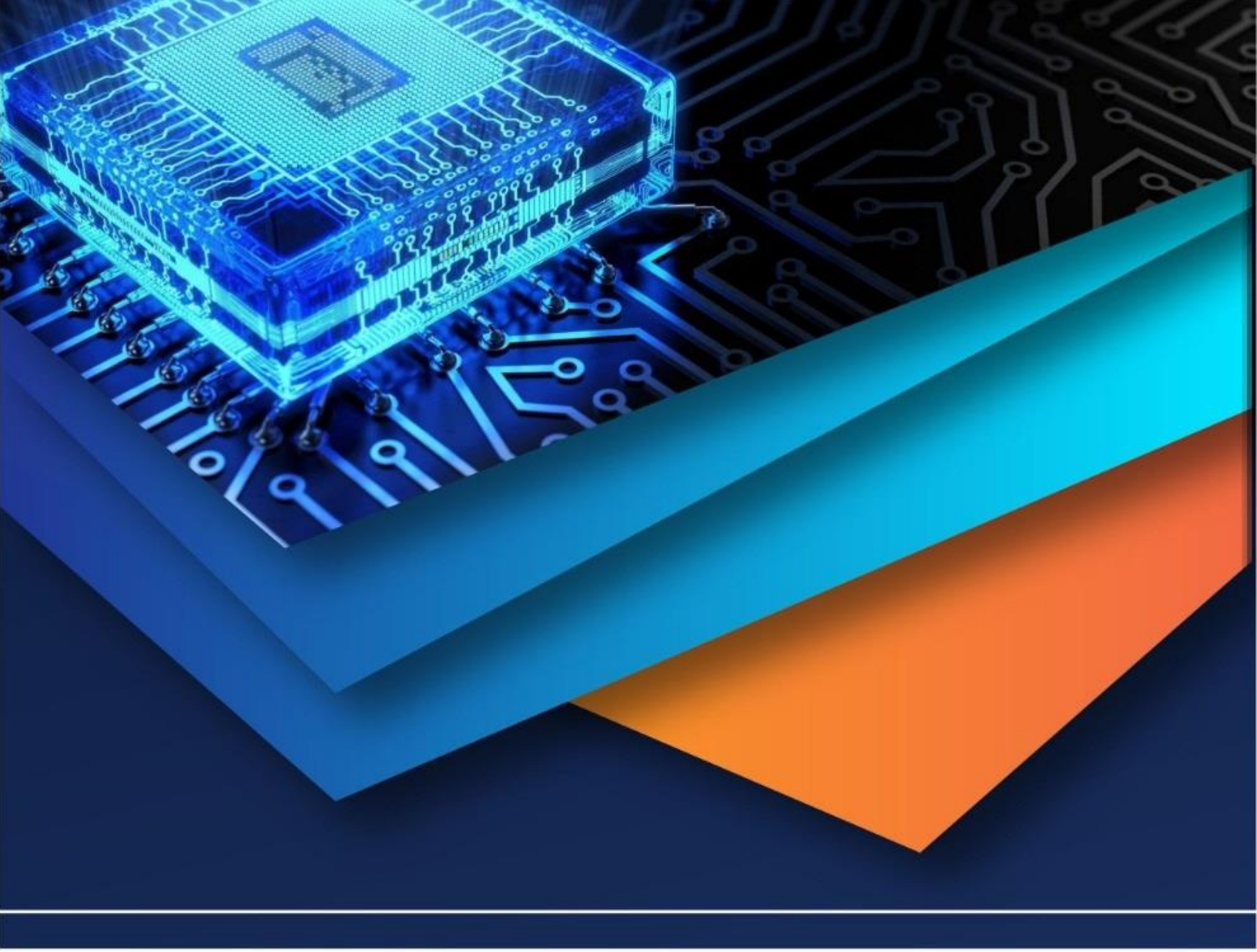

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