Solar powered Smart Ultrasonic Rodent Repellent with DTMF and Manual Control for Poultry farms

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Abstract: - The paper represents a detailed survey on various methods and devices used for repelling insects and rodents in farming lands and in poultry farms. Earlier days various manual methods were employed and later on as advancements occurred in electronics those were gradually used in farming to help them and to increase their yield. The advancements in the fields of electronics have reached to great extent by incorporating various technologies to create an application.

Key Words – ***Ultrasonic, Rodent Repellent, DTMF, Audrino.***

I. INTRODUCTION

In paper [1] they discuss about creating a working model which is capable of emitting ultrasonic energy with variable frequencies. The varying frequencies affect the auditory senses of pests such as nocturnal insects, rodents and certain type of avian. Their design consists of electronic components such as astable multi vibrators, counters D- flip flops, NPN, PNP transistors, few variable resistors and so on. They were assembled together to form a circuit which was tested successfully on mice and best results were obtained at a distance of 15 meter from the model circuit. The author suggests some modifications that can be carried out by using advanced or application specific microcontroller and ultrasonic sensors for different band of frequencies.

Due to prolonged usage of pesticides and herbicides it has become toxic to humans in that case electronic pest repellent is more reliable it has been discussed in [2]. the author has done a detailed review on different types of challenges faced in repelling insects, avian and rodents.

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The pests mainly feel uncomfortable in sound frequency range from (10-100khz) this frequency range will create an intense auditory stress so they eventually move away from the device. The author doesn't give any distinct solution but generally guides over the necessity of electronic repellent for the farmers. The electronic pest repellent can be upgraded by incorporating other technologies such as DTMF [3]. In this paper the author has discussed about design and development of DTMF controlled room cleaner robot. This device has obstacle avoidance capability along with waste and dust cleaning system. In order to avoid human assistance this device is DTMF controlled i.e., it has in built microcontroller platform and remote controlling operation. The author emphasises in using this technology in various fields where remote operations are necessary and also says automatic charging of remote applications can be taken as future challenges and more focus can be given to wireless charging.

In this paper [4] the author discusses about edge computing and its role in real time application development by increasing storing capabilities end to device in order to increase the response time and reduce the latency and secured data exchange. The authors have detailly evaluated various edge computing such as raspberry pi with real time object detector which is custom trained in identifying the animals with the help of specially created hardware and software platform with integrated ultrasound generator. The results show how the multiple techniques can work with feasibility in repelling the animals along with animal detectors and power efficient edge computing technologies by satisfying the real time requirements. In real time application we need environmentally

friendly low powered devices for IOT applications in order to avoid board failure and running out of batteries. Due to real time monitoring of animals the motion sensor fails to detect the movement of animals so the motion sensors have to be selected precisely for real time application. But this paper opens a way for usage of IOT based devices for real time application.

In continuation to the previous paper here [5] the author has added some more technologies to create an application specific device for repelling vermis and snakes. Along with motion sensor and ultrasonic sensor a GSM module and Arduino uno board has been used. So, both motion sensor and ultrasonic sensors work continuously by driving the vermin and sensing the motion of snakes. If the snake movement is sensed by the sensor, it will intimate the Arduino uno kit to change ultrasonic frequency to dive the snake away and it activates the GSM module to send message to the farmer indicating about the presence of snake in his farmland. The author has successfully tested this kit in selected area and the application of the kit can be further extended to cattle monitoring.

Electronic repellent devices (EPR) have been discussed in sufficient way in many papers in this paper [6] the author mainly gives us a review about efficiency test protocols and regulatory actions taken by the environmental protection agency. A brief regulation has to be framed for selecting the frequency ranges, pulse rates, duty cycles and intensity levels. The commercial ultrasonic devices have reduced the activity movement by 30-50 %. Due to prolonged use, it may cause distress in the brain of the animals in order to avoid that suggestion have been given in using frightening alarm or producing irritating odour which would eventually drive away the animal.

The study has been conducted to create a prototype to dive away the birds from the farm it can be simply termed as bird repellent system [7]. The author discusses about developing a prototype module for repelling birds by using a motion sensor which eventually capture the pictures of bird movement and sends it to the microcontroller. Here the motion sensor used is nothing but the camera sensor which captures the pictures in frames it is then processed by the microcontroller and it actuates the sound frequency to drive away the birds. The author created a prototype using raspberry pi as microcontroller event though the prototype has been tested more commercially efficient camera sensors have to be used to develop a commercial kit here the author emphasises on making more investigation for both computing and creating commercially efficient IOT.

This paper was mainly taken in this review due to the usage of solar powered concept in bird repellent system [8] here the author mainly focusses on using solar power and reviewing different types of sounds that scare away the birds. The hardware and software part were designed, the components such as solar panel, amplifier, class D audio amplifier, speakers, Arduino uno microcontroller are used and a special algorithm was created for producing different sounds. Initially this system was designed to create only two types of sounds but later on when the birds became familiar with the sounds a special algorithm was required to produce scarier sounds .so the algorithm was specifically written to meet this purpose. The author believes that this prototype model will help in better understanding of birds and methods to control those groups.

From all the papers discussed above the power backup and changing of batteries is a big issue so we need to focus on alternate methods such as energy harvesting. in this paper [9] the author discusses about the necessity and about efficient way to harvest it. For harvesting this energy, the author suggests to form cluster heads for improving the efficiency of harvested energy. They have proposed a GEEC design for intra and inter cluster routing for harvested energy to improve the performance of WSN. the scalability, applicability and efficiency of EH technology can be further improved by focussing on network lifetime and identifying the precise nodes.

Energy harvesting [EH] for autonomous WSN is a widely spoken technology here this paper [10] is a basic tutorial related to EH topic. The batteries can become absolute after few decades some alternate methods have to focussed for power generation from renewable source for operating applications in remote fields. The author discusses about existing WSN and their pros and cons. Commercially available systems are bulk which doesn't suit many applications. Thus, the author emphasises in focusing on the system level optimisation of these harvesting devices.

The papers [9],[10] mainly focusses on the necessity of energy harvesting and the challenges present in that field. In this paper [11] the author discusses about designing intelligent EH systems. This article mainly focusses on creating a mathematical tool to analyse the energy management policies for EH, however the author says that communication and electronics engineer must work together for developing smarter and more reliable EH.

The author of this paper [12] gives us an idea to harvest electricity from traffic noise using piezoelectric transducer and super capacitor, the noise level should be up to 75dB to generate 5.5volts approximately. The prototype of this model was fixed at a height of 5.6m without obstructing the pedestrians. In the later part of this paper the recommends to find alternative to the

piezoelectric transducers for efficient conversion of energy which can be used to power up higher consuming applications. In paper [13] the author shows small scale model using piezo electric crystal for energy harvesting. this model was test on an induction motor where vibration from the motor was converted in to electrical signal around 2.96 volt got generated in this process. The paper [12] discusses conversion of sound energy in to electrical energy and paper [13] discuss about conversion of vibrational energy in to electrical energy. Further research has to be continued to implement both sound and vibrational converting technology in one application.

II. EXISTING METHODOLOGY

Many existing technologies were detailly discussed in the above section. Each paper focuses on different technologies and techniques. Such as development of electronic repellent systems in paper [1][2]and usage of DTMF technology in [3]. the GSM technology can be added with the existing EDR. The charging and replacement of batteries has become a big challenge and many solutions for this existing situation is detailly discussed in [9][10][11][12][13]. All the above-mentioned techniques and technology are available individually they can be combined together by overcoming their challenges in my proposed work.

III. PROPOSED METHODOLOGY

3.1 Let S is the system

In this proposed technology a smart gadget has been designed to avert the rodents from the poultry houses and in farmlands. The performance analysis and development of rodent repelling device has been demonstrated. The device can be controlled from certain distance by using DTMF technology. To control the movement of rodent during night time LDR has been employed. In order to overcome the problems on battery replacement a solar panel has been used along with Arduino uno microcontroller with solar regulatory circuit.

The ultrasonic frequency generator unit can generate a fixed or variable frequency range depending on the user's preferences. A solar panel and a rechargeable DC battery unit are used.

There are three types of controlling unit. They are: a) Remote control using DTMF technology, b) Automatic night mode via LDR, and c) Manual Control Unit. There are five modes on the device. The first three variants are capable of producing frequencies ranging from 20 to 100 kHz. Combination modes and night mode are the other two options.

2.2 FREQUENCY GENERATION UNIT

Frequency is a factor in all kinds of sounds. The ultrasonic sound was generated using an Arduino Uno microcontroller and a crystal oscillator. It's used to generate a square wave with a given duty cycle on a digital pin. The pin is wired to an amplifier circuit based on an LM386 power amplifier with an 8-ohm impedance.

Two of the Arduino board's timers are used to play back the audio. A high-frequency square wave fig 1 with a duty cycle that corresponded to a certain value (amplitude) in the audio sample was generated using a single timer. Another timer is utilized to refresh the duty cycle on a regular basis.

Depending on the user's input, the microcontroller unit can operate in a variety of modes. The microcontroller generated a square wave signal in each mode, with the frequency changing continually to form a frequency range.

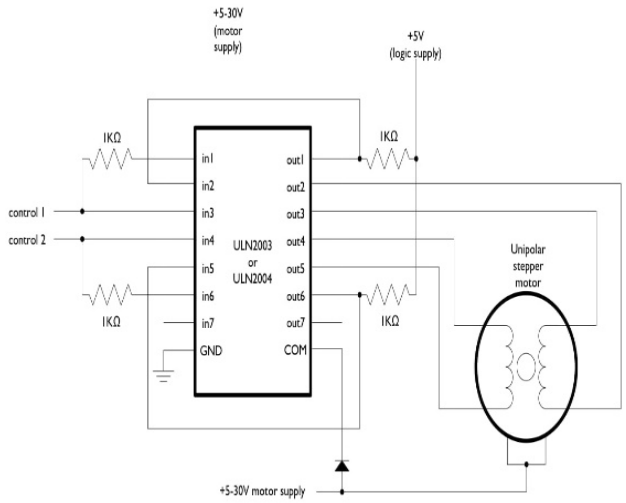

Fig.1. Relay circuit connecting stepper motor

3.3 CONTROLLING UNIT

Three controlling systems have been designed for the proposed system. The very first DTMF-based control system. DTMF is a technology that allows you to control a gadget from a long distance using a GSM phone. The remote-control function is developed fig 2 using a DTMF receiver MT8870, which includes a bandpass filter and a digital decoder capable of encoding 16 DTMF tone to pairs to code 4 bits. When the phone's keypad buttons are pressed, DTMF is the signal that will be sent to the Arduino Uno. The high and low frequencies of the keypad buttons on a mobile phone produce two separate tones.

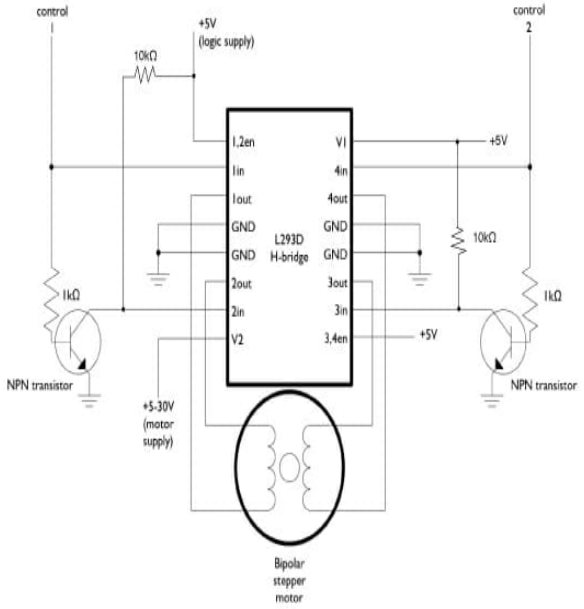

Fig.2. Motor driver circuit

Manual switches are used to regulate the second system fig 3, which has five settings to choose from. Digital pins D2 to D6 have been attached to five switches. The third controlling unit makes use of an LDR that is connected to analogue pin A4 and is utilised to determine day or night in order to activate night mode. If the user only wants to use the device at night, LDR will recognise the time and activate the device. The below table [1] gives comparison of different types of frequencies and the distance of the rodents from the kit and the secs of response of the rodents.

Table.1. Frequency range using DTMF technology.

Frequency	Distance (Meter)	Mins of response (Seconds)
70KHz	1m	10 secs
	2m	15secs
80KHz	1m	5secs
	2m	8secs
85KHz	1m	3secs
	2m	5secs

The microcontroller has been connected to a 16x2 LCD display via SPI communication, and the LCD display can display various information about modes and frequencies.

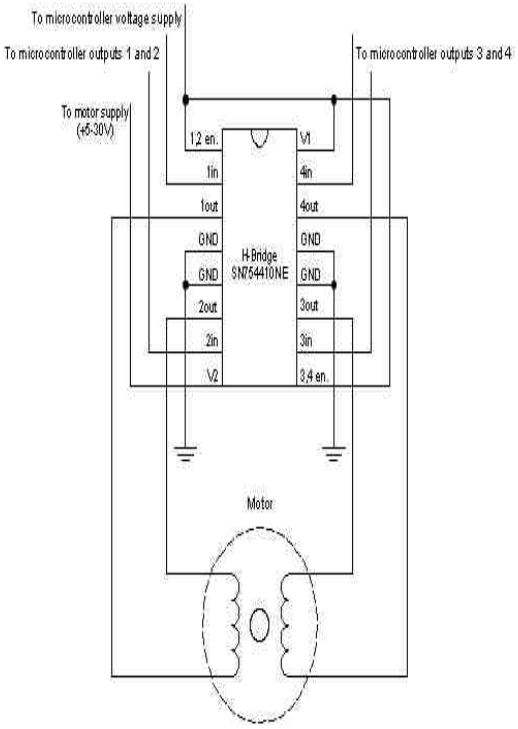

Fig.3. Circuit to switch polarity

3.4 WORKING OF THE MODEL

The rat repellent is activated by the phone's keypad or by a manual switch. Rats will be repelled by the ultrasonic sound range created by the device. From 60 KHz to 85 KHz, the frequency ranges vary.

The devised technology was put to the test on a rat in a cage to see if it could have any effect on a living organism. When ultrasonic sound was varied between 60-85 kHz frequency ranges, the rat displayed disturbed behaviour, proving that the designed system is useful in repelling dangerous organisms form poultry farms.

With the proposed design, the device can run for up to 12 hours on a fully charged battery. A high-efficiency battery and solar panel, on the other hand, can provide superior performance.

The proper mentioning of the developed system's working principle is done with the proper implementation figure [4] of the system using Arduino, as well as multiple controlling modes to control the developed system from any remote location.

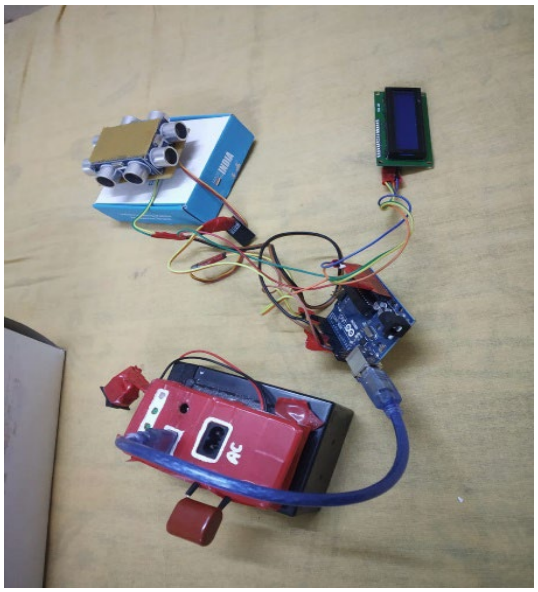

Fig.4. Implementation of proposed model

IV. CONCLUSION

Sound and air pollution are caused by traditional noise systems and chemical pesticides, both of which are detrimental to humans. This form of pollution will not be created by the clever ultrasonic sound repellent gadget. Furthermore, it is environmentally friendly because its charging system is entirely reliant on a solar panel.

However, high-efficiency solar panels, such as thin-film solar panels, which are lighter than traditional silicon solar panels, can provide superior performance. As a result, the overall weight of the device will be reduced. Although this research looks at the impact of ultrasound waves on pests, more research into ultrasonic waves as a means of managing pest behavior is needed.

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