Electronic PEST Controller

K.M Shubhashri[1], Mabel Jane R[1], Misba Seemath[1], Nidhishree R Rao[1],
Yashonidhi Yajaman[2]
1Students, BE, Department of ECE, GSSSIETW, Mysuru, Karnataka, India.
2Assistant Professor, Department of ECE, GSSSIETW-Affiliated to VTU, Mysuru, Karnataka, India.

Abstract - Biological and repellency effects of differing ultrasonic signals along with distinct wave shapes and frequencies on larvae, pupae and adult pertaining to the pests were analyzed in various laboratory conditions. Tests based on numerous frequencies were performed by the designed device, signal generator. The required tests depicted that the ultrasound frequencies largely impacted on the characteristics of the moth. The significantrepulsion effects of ultrasound were recorded at 38-48 kilohertz frequencies. The above proposed method is economical andeco-friendly because there is no usage of chemicals and non hazardous to human being

I. INTRODUCTION:

Chemicals used in the pesticides are extremely toxic and they behave like slow poison and is harmful to human beings, wildlife and agricultural lands[1]. 43860 gallons of pesticides are being used in India every year. 91.9 million hectares of land cultivated with Maize, Cotton, Sorghum and so on is getting affected by pests every year in the country[1]. The usage of these chemicals is leading to air pollution and this is one of the primary risk factors for diseases related to the respiratory system. As per the statistics, the intake of pesticides is leading to poisoning which is resulting in the death of close to 10000 people per year.

As per the survey done by the UN, 200000 people die every year from pesticide poisoning globally[1]. It is possible that pests can be repelled by ultrasonic frequency in the range 38 kHz- 48kHz[4]. This is done by emitting pulse ultrasonic waves. Ultrasonic waves create a clamorous and vicious environment repelling the pests[4]. However it is absolutely safe for humans and other animals. In order to increase the efficacy of the system, the frequencies coming out of the ultrasonic oscillator is to be varied continuously at different ranges[6].

Agrostis Ipsilon:

The fully grown ipsilon is a medium-sized moth which is light brown in color. These moths lays eggs on the tissues of the plants that are tender. It will take around 3 to 7 days for these eggs to hatch[2]. The adult larva is about 35 mm in length and greenish- brown in color and has yellow stripes on its body[2]. The larvae of the ipsilon turns into an adult in a span of 17 to 22 days. The pupae will be present beneath the soil for 6 to 12 days and hibernate as pupae. It takes about 4 to 6 weeks for the entire life cycle of the moth to get completed[2]. These insects will have 5 to 8 generations per annum.

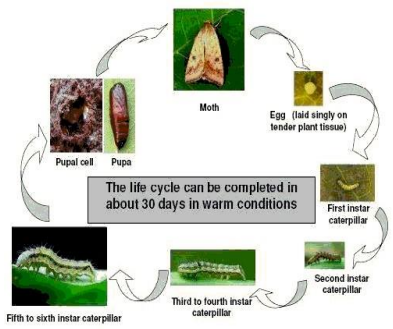

Figure: Life cycle of Agrotis Ipsilon

Egg:

The egg stage of ipsilon is between 3 and 6 days[2]. Female ipsilons deposit eggs in groups on the lower surface of leaves. If such leaves are not available, the female ipsilons will lay eggs on plant materials that are dead. However, these moths do not deposit their eggs on bare soil. Female ipsilons can deposit eggs either singly or in groups. They can lay up to 1200 to 1900 eggs[2]. The eggs that are almost spherical in shape are white initially. Later they turn brown with age. There are around 35-40 ribs on the surface of the egg. All of these ribs originate from a single tip[2].

Caterpillar:

The larval stage of ipsilon will last for about 20–40 days. Between 5 to 9 days , the body of the caterpillar grows from 3.5 mm to a max of 55 mm. The larval growth is enhanced at 27 degrees Celsius temperature. At the end of 3rd instar, the larvae turns sensitive to light and thus remains beneath the ground most of the times during the

day. Larvae are deemed as pest as it damages the tissue of the plant beneath the soil[2]. The larval stage is primitive. These will have a color ranging starting from light gray to black. The ventral side is normally lighter, and these moths do not posses a dorsal band. The body of these moths contains granules and the head is covered with several dark spots[2].

Pupa:

The third stage, pupa extends between 12 to 20 days. These moths pupates beneath the soil at 3 to 12 millimeters below the surface[2]. The color of the pupae changes to darkbrown at this stage and extends up to
12 to 17 millimeters long and 5 to 6 millimeters wide[2].

Adult:

This stage lasts for 35 to 60 days, which begins at the egg stage. The pre- deposition period of the female ipsilon lasts for 7 to 10 days. The wingspan of adult ipsilons varies between 40 to 55 millimeters[2]. The forewings are dark brown in color, and it has a light irregular band at the distal area. It also has a black mark that resembles a dash. The moth posses hind wings which are whitishgray in color and their veins are dark colored[2].

Aim: To develop an Electronic Pest Controller that restricts the pests from harming the agricultural field and thereby protecting the crops and its yield.

Objectives:

- To come up with a pest controlling system which works on ultra sound.
- To get rid of detrimental pests without the usage of chemical pesticides.

II. PROPOSED LOGIC:

Agrotis Ipsilon, is a universal genus with 317 species. All Agrotis larvae are ravenous and are able to feed on a variety of hosts. They will have underground habits of coming to the surface at night to feed. While feeding, they tend to cut the stems of the food plants, causing severe damage and speedy crop loss. When disturbed, Agrotis larvae will roll up in a very characteristic behavior. Larvae of Agrotis Ipsilon are plant feeders, attacking various herbaceous, native and cultivated plants, including many economically relevant crops such as barley, bean, beet, cabbage, cauliflower, clover, coffee, collard, corn, cotton, cowpea, cucumber, flax, garlic, lettuce, melon, oat, onion, pea, pepper, potato, rice, sorghum, soybean, squash, strawberry, sunflower, tobacco, tomato and wheat. Larvae often build on a covered tunnel which is used as a hiding place during the day, and as a place to feed the host plants and will be cut during the night. It is possible that Agrotis Ipsilon can be repelled by ultrasonic frequency in the range 38 kHz- 48 kHz. Therefore, to achieve this frequency the below prototype is developed.

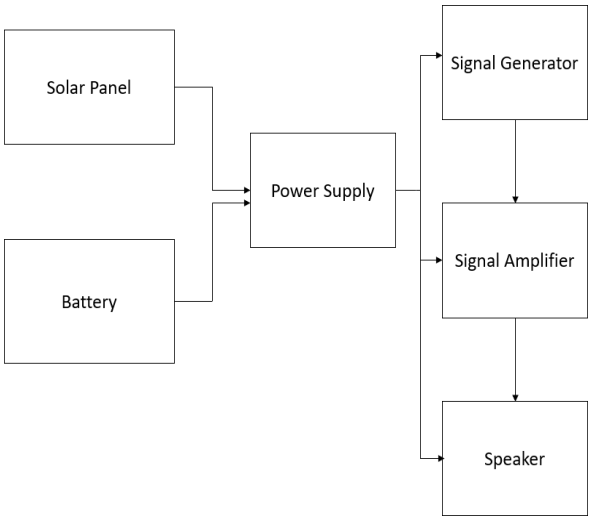

Figure: Block Diagram of the proposed prototype

System specification:

The modules used in our prototype are:

i. Solar panel
ii. Battery
iii. Power supply
iv. Signal generator
v. Signal amplifier
vi. Speaker

The solar panel is chosen with 15 watts of power with 9 volts amplitude of reference. We have integrated solar panel in order to make our system power independent. A 12 volts battery is used as power supply to the prototype. A power supply is set up from the energy generated by solar panel or battery in order to provide the power for the functioning of the signal generator, signal amplifier and speaker.

The signal generator is used to generate the ultrasonic signal of desired frequency in the range 38 kHz-48 kHz along with the amplitude of 5.5 volts.

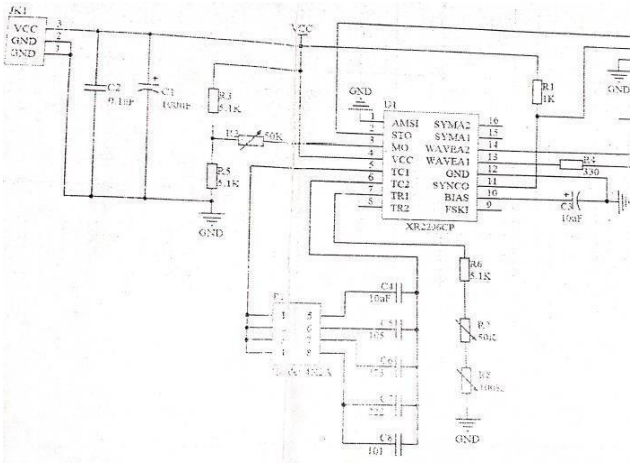

Figure: Circuit diagram of signal generator module

The repellency of the moth Agrotis Ipsilon was found to be 42 kHz. Therefore the above circuit diagram is designed to generate the above frequency of ultrasound.

Listed below are few other moths of the noctuidae family and their frequency of repellency.

Sl no.	Name of the moths	Frequency of repellency in kHz
1	Asto caricae	40
2	Achaes janata	39
3	Olepa ricina	41
4	Cyana ridleyi	43
5	Artena dotata	38
6	Chalciope mygdon	45
7	Dysgonia stuposa	46

Agrotis ipsilon

Asto caricae

Olepa ricina

Dysgonia stuposa

I. RESULT:

The figure 1 shows the circuit designing of signal generator and the generated ultrasonic waves of the desired frequency 42kHz is as shown in figure 2.

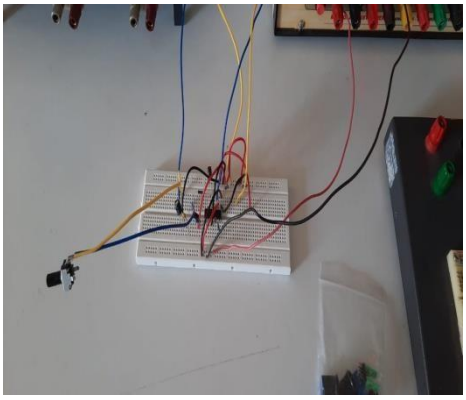

Figure 1: Circuit of signal generator

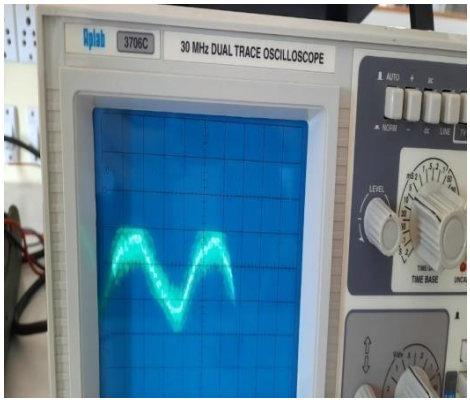

Figure 2: Output of signal generator

The below snapshot shows the moth Agrotis Ipsilon placed in a polythene bag which is about to get disturbed from the ultrasonic waves generated by the signal generator module which is transmitted through the speaker.

The below snapshot shows that the moth Agrotis Ipsilon is disturbed by the ultrasonicwaves generated.

Electronic Pest Controller is the best alternative for the hazardous chemical pesticides and it is used in agricultural fields.These controllers are economical, ecosystem friendly. They have no known risks to humans.It is re-usable unlike the chemical pesticides that get washed away over a period of time.

II. CONCLUSION:

The pesticides causes acute effects-which is a short term healtheffect. It also causes longterm or constantly occurringadverseeffect that will occur in the long run after the usage of these pesticides. Examples of acute health effects include diarrhea, rashes, dizziness, vomiting, blindness, blistersandconstipation. The chemicals can bio-accumulate in the body and also in the food chain over time. Exposure effects ranges from mild skin irritation to blood and nerve disorders, coma, endocrine disruption, birth defects, genetic changes, tumors or leading to death. To overcome the above drawback of chemical pesticides, the electronic pest controller is designed as it uses the ultrasonic waves which are economical, eco-friendly and also efficient device to repel the moths away from the farms.

III. FUTURE WORK:

As farmers are responsible in feeding the world, the crop production has to be increased to a higher level and must be made toxic free. This device can be employed in agriculture by various groups of farmers, both large and small scale in order to repel these deadly pests. Saying goodbye to chemical methods of pestcontrol will be considered as greaterachievement now and in future. The focus of further research and development will be on how these ideas would be implemented to put forward an effective electronic design for electronic pest control devices that are capable and successful enough to overcome the present challenge of pest infestation and also settling the controversies surrounding the effectiveness of such applications.

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[7] A Novel Oscillator with Different Nature of the Equilibria and Its Analysis

[8] Noise predictions for optoelectronic oscillators using different models.

[9] Sinusoidal and Square Wave VoltageControlled Oscillators

[10] Lossless Feedback Amplifier Design

[11] High Efficiency Amplifier and Signal Source Module for ISM-band Applications

[12] Accurate, Wideband Characterization and Optimization of High Power LDMOS Amplifier Memory Properties