

**Figure 1:** Block diagram of Designed and Constructed Solar Powered Multi- tone Ultrasonic Rodent Repeller

**Power Supply:**

The solar cell power supply of 12V, 50 watts was connected to power the circuit. Photovoltaic or solar cell is a device that converts solar energy to electrical energy [12, 13].

**Battery Cell (Accumulator):**

The battery cell of 12V was used as a backup power source in case there is no sun.

**Charge Regulator:**

Charge regulator is very essential to keep the life the accumulator. The charge of the accumulator by the solar cell needs to be regulated to avoid overcharging or over discharging the battery which may lead to shortening the life span of the battery. In this design a dual op-amp comparator circuit was used for the regulation [12,14, 16].

**Automatic Voltage Switch:**

Here a shift register (i.e. 4017) automatically shifts the voltage  $V_{cc}$  to the required 555 timer circuit at the time interval which is determined by the clock of an astable multivibrator.

**Frequency Generator Circuit:**

In this design and construction, an integrated circuit of 555 timer astable multivibrator was used to generate an electrical signal of the needed frequencies as shown in fig 2. This signal was converted to ultrasonic frequencies using a transducer, otherwise known as piezo speaker. The different frequencies generated were made possible with the help of a shift register, which automatically switches voltage ( $V_{cc}$ ) to the particular timer circuit that oscillates at the needed time interval which is determined by the clock of a decade counter, which is designed to produce a chain of pulse train for the shift register. The output of this signal is made symmetrically by producing a sample of high frequency pulse train inputs and its compliment which were needed to produce an output signal which is in anti-phase with each other (-ve and +ve). This was further amplified accordingly through a power amplifier to a level required to drive the piezo speaker [12-16].

The frequency of the 555 timer is calculated thus: [12-16].

$$f = \frac{1.44}{(R_1 + 2R_2)C}$$

Where  $R_1=15\text{ k}$  and  $R_2=60\text{ k}$  are resistors,  $C=330\text{pF}$  is capacitor

$$f = \frac{1.44}{330 \times 10^{-12} \times (4.7 \times 10^3 + 2 \times 60 \times 10^3)}$$

$\therefore f = 35\text{ kHz}$

Hence, following the same procedures, the other frequencies were obtained as 38 kHz, 40 kHz and 50 kHz.

Also the time interval during the output high and low of the timer is expressed as [12-16].

$$T_{\text{high}} = 0.7(R_1 + R_2) C$$

$$T_{\text{Low}} = 0.7RC$$

Hence

$$T = T_h + T_L$$

$$T = 0.7(R_1 \text{ and } R_2) C$$

**3. Results and Discussion**

After the design and construction of the solar powered ultrasonic rodent repeller, four frequencies are generated and are thus: 35 kHz, 38 kHz, 40 kHz and 50 kHz. These frequencies were confirmed using a frequency detector. The designed and constructed solar powered multi-tone ultrasonic rodent repeller repelled the rodents when introduced on it to confirm the efficiency of the device as shown in fig 3, 4 and 5.

Multi-tone ultrasonic repeller is an effective and best method of eliminating or eradicating rodents in a particular environment and hence the multiple tones do not create room for rodents to be accustomed to a particular sound. The ultrasonic frequency repeller was discovered as an alternative measure for repelling rodents rather than the use of trap and chemicals (otherwise called poison).

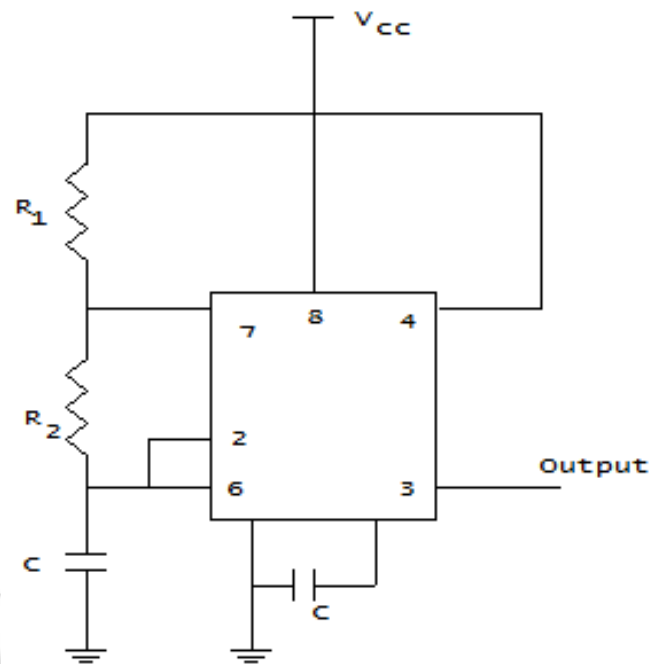
**4. Conclusion**

The ultrasonic repeller is an application of Science and Technology used in controlling rodents. The repeller has no side effect unlike chemical and trap which is dangerous to man especially in a place where there are children and their pet. It does cause any harm to the environment or interfere with the freshness of air. The operation of the device is easy and straight forward. The device is durable when handled carefully and the maintenance is cheap as compared to the ones designed to use alternating current or battery as power supply since it uses solar energy. However, it is only the cost of construction that is required; using the device does not attract any additional money since it is solar powered. Hence it can be used in homes, villages, farm yards, gardens and stores where electricity is not installed.

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**Figure 2:** 555 timer that is connected in astable multivibrator that produced ultrasonic sound used to eliminate rodents.



**Figure 3:** The rat is seen running away from the room as a result of the ultrasonic frequency.



**Figure 4:** The rat is seen irritated and demobilized as a result of the ultrasonic repeller.



**Figure 5:** The mice is seen disturbed and irritated and is trying to run away from the room because of the ultrasound from the repeller