



UNDERSTANDING THE WORKING OF THEREMIN AND MAKING IT

ELECTROMAGNETISM PROJECT REPORT

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INTRODUCTION

The theremin sometimes seems like an instrument from Earth's future or another world. Its music seems conjured from nothing, notes and tones teased and manipulated by hypnotic movements of hand and fingers through air. Theremins involve the manipulation of electromagnetic fields around two antennae that make the instrument look rather like a weird lectern. Player's control sounds by moving hands and fingers around a vertical antenna to raise or lower the tone, and up or down over a looped antenna to control volume. Theremin is the first electronic instrument that you can play without touching.



HISTORY OF THEREMIN

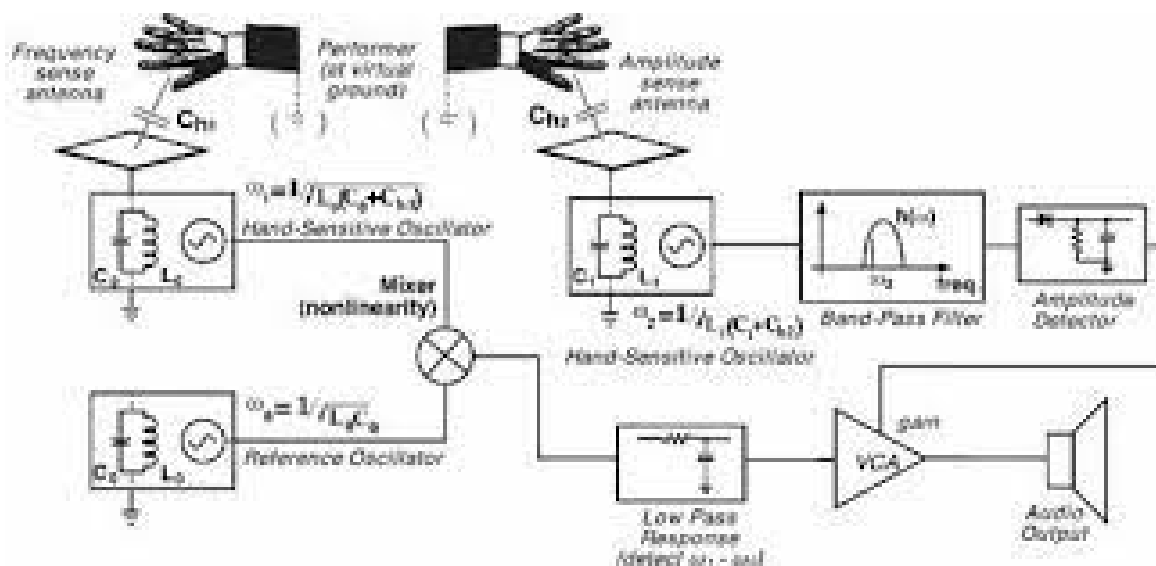
In the early 1920s, physicist Léon Theremin was doing research on proximity sensors for the Russian government. He was trying to develop something like a land-based sonar device using an electromagnetic field to detect objects that entered a certain zone. Instead, Theremin came up with a musical instrument: his namesake, the theremin. Hailed as the world's first electronic instrument, avant-garde composers like Joseph Schillenger immediately recognized the potential of Theremin's device. In 1929, Schillenger premiered his "First Airphonic Suite" in New York City, and his theremin soloist, Léon Theremin, became the talk of the town. RCA quickly snapped up manufacturing rights to the Thereminvox and hatched an advertising campaign designed to sell a theremin for every living room in the country.



THE SCIENCE BEHIND THEREMIN

Way back in the early 1920s, when Léon Theremin worked at the Physico-Technical Institute, he noticed that when he moved his body in or out of an electromagnetic field produced by a radio frequency oscillating circuit, he changed its frequency. The human body has a certain natural capacitance (the ability to hold an electrical charge). What Theremin observed when he used his body to disrupt the oscillator's electromagnetic field was the effect of this capacitance. Theremin began pondering how to exploit capacitance to create a new musical instrument. What Theremin dreamed up was an electronic instrument with two primary circuits: a pitch circuit and a volume circuit. The pitch circuit used two tuned (radio frequency) oscillators: a fixed oscillator and a variable oscillator.

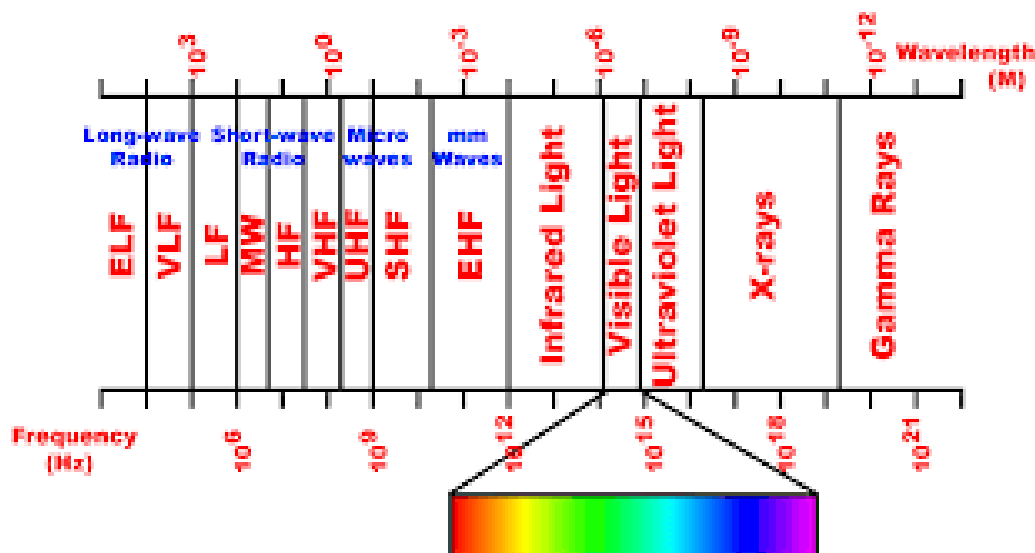
The fixed oscillator generated waves at a static frequency. The variable oscillator was capable of producing a range of frequencies and was connected to a vertical antenna. Through a process called heterodyning, signals from the fixed and variable oscillators were mixed together. The frequency of one oscillator was subtracted from the other. The difference was amplified and, finally, output as an audible musical tone. The second circuit (the volume circuit) controlled the level of the tone generated by the pitch circuit. Much like in the pitch circuit, it used an oscillator connected to an antenna. Disrupting the electromagnetic field around this antenna raises or lowered the volume of the music tone generated by the pitch circuit.



CONCEPT REQUIRED

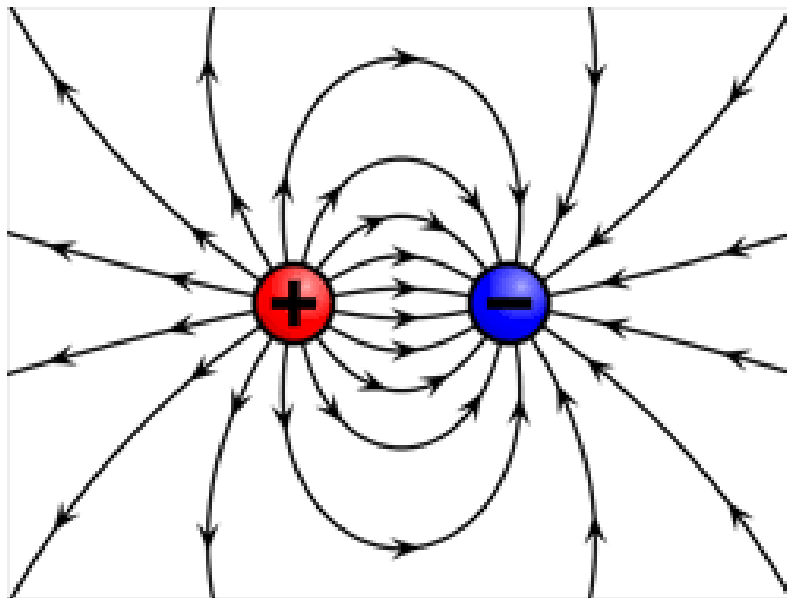
RADIO WAVES:

Things like radar and microwave ovens depend on radio waves. Things like communication and navigation satellites would be impossible without radio waves, as would modern aviation -- an airplane depends on a dozen different radio systems. Radio frequency (RF) is the oscillation rate of an alternating electric current or voltage or of a magnetic, electric or electromagnetic field or mechanical system in the frequency range from around 20 kHz to around 300 GHz. This is roughly between the upper limit of audio frequencies and the lower limit of infrared frequencies; these are the frequencies at which energy from an oscillating current can radiate off a conductor into space as radio waves. Different sources specify different upper and lower bounds for the frequency range

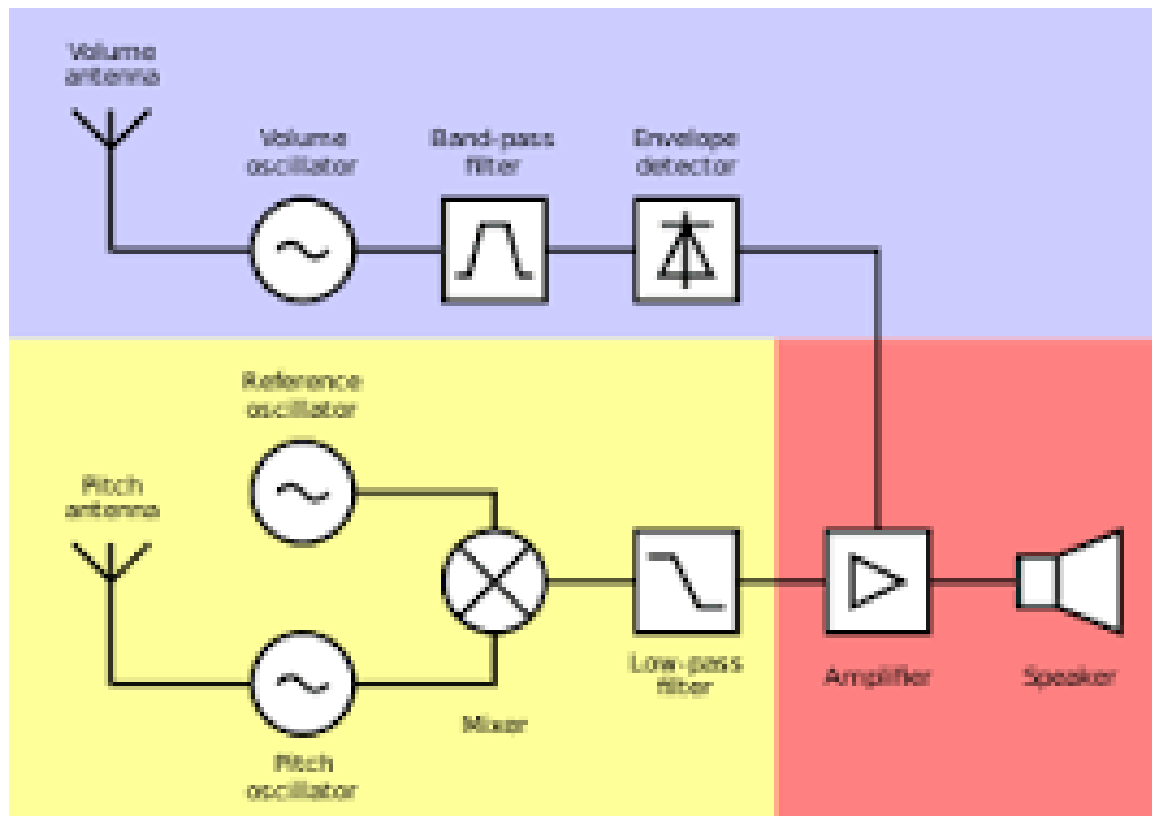


ELECTROMAGNETIC FIELD

Electromagnetic fields are a combination of invisible electric and magnetic fields of force. They are generated by natural phenomena like the Earth's magnetic field but also by human activities, mainly through the use of electricity. Mobile phones, power lines and computer screens are examples of equipment that generates electromagnetic fields. Most man-made electromagnetic fields reverse their direction at regular intervals of time, ranging from high radio frequencies (mobile phones) through intermediate frequencies (computer screens) to extremely low frequencies (power lines).



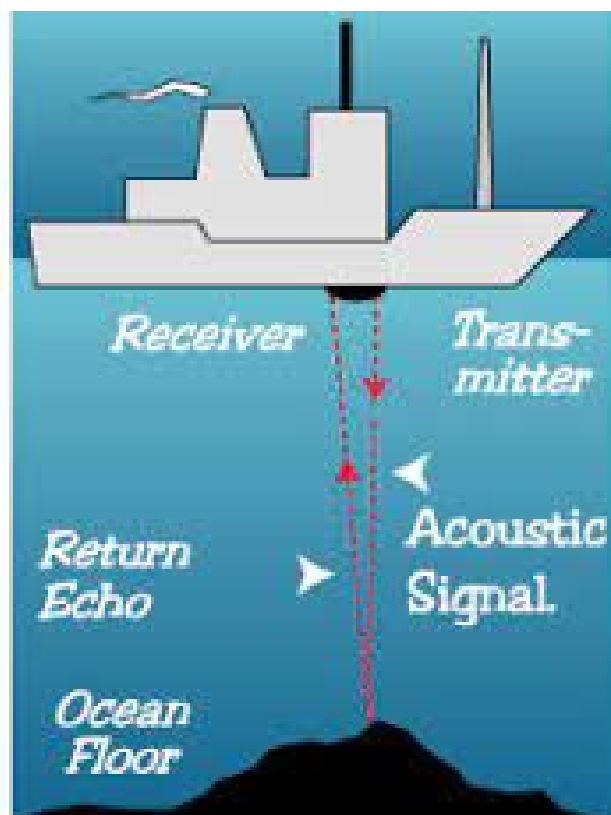
BLOCK DIAGRAM OF THEREMIN



USE OF THIS CONCEPT

water table depth :

In cities if we want to identify the water table for ground water, there the concept used in theremin is used . We know that microwaves show the property of absorption with respect to water and it passes unhinged through other mediums. What we do is that we use a transmitter to transmit microwaves and then we analyse the received signal and if the received microwaves intensity is less that the transmitted one , then water is detected , as water absorbs a part of microwave . A similar concept is used in theremin wherein we observe a change in the received signal due to the interference caused by the movement of our hands.

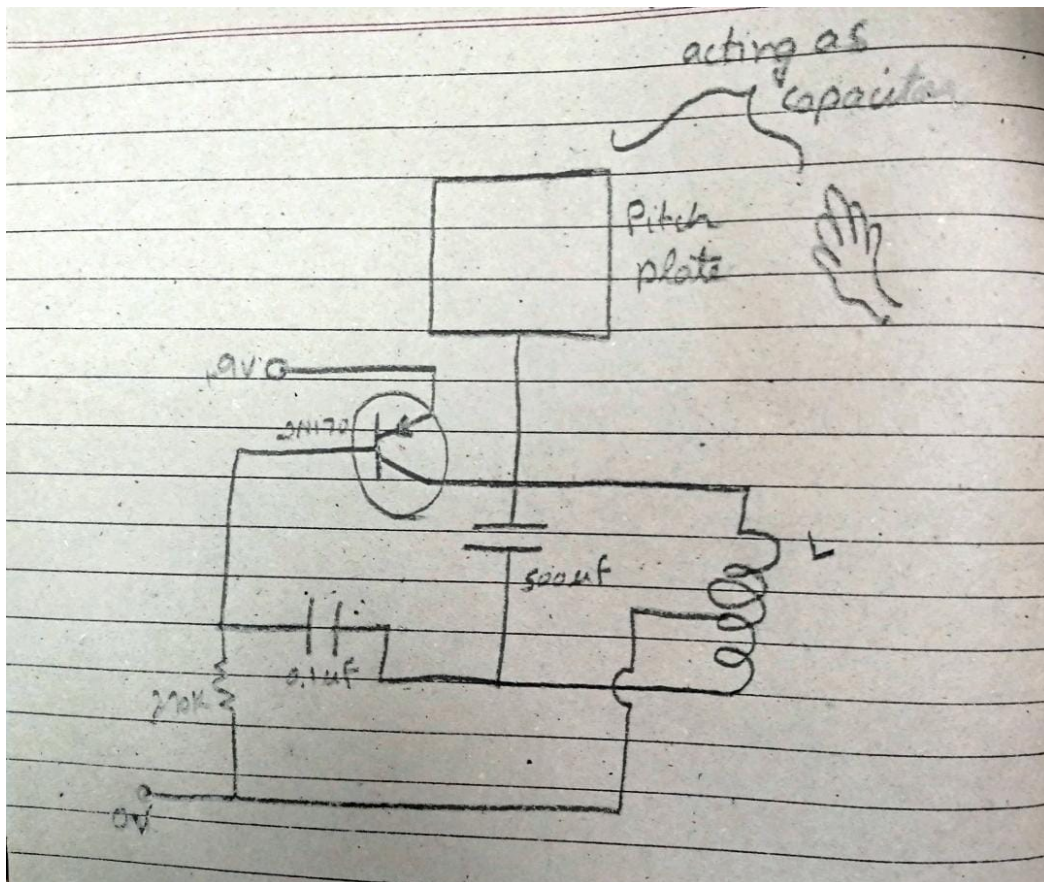


In finding the hot and cold currents in ocean :

The concept used in theremin is also used in finding out the warm water currents in the ocean . We know that warm and cold water interact differently with radio waves by using this knowledge we find out the interface of ear and cold currents .The impedance offered by warm water is different from that offered by cold water .When the radio frequency beam is subjected at the interface of warm and cold currents, at that point some part of the wave reflects and some gets transmitted. If the reflected part is more than the transmitted , then warm water currents are detected . This concept is used while doing the construction of dams as it detects the warm water currents where most of the aquatic life is present.



CIRCUIT DIAGRAM



FUTURE SCOPE

We see that the noise produced in theremin is the work of the movement of hands this concept on which theremin works can also be used in other instruments wherein we can place another level before antenna that will produce different tones and hence we can make instruments work based on the gestures of our hands. Also in order to prevent the production of noise due to other unwanted interferences, we can use some metallic isolating bars conforming the antenna array, that can be placed around the theremin pitch area.



CONCLUSION

In conclusion to my report I have studied the working principle of theremin and have also studied its various applications in other fields . I have also tried to understand its construction and have implemented it as well. This instruments has introduced a concept which can be used in various fields to minimize the complexity of the instruments.

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