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THE SYNTHESIS OF BIO ACOUSTIC MUSIC USING PLANTS

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Abstract: Plants have evolved a variety of plant structures and cell walls with mechanical qualities that are crucial to the economy as a result of their responses to biotic and abiotic challenges. Bio acoustic methods have been used to monitor plant health, photosynthesis, ecology, and the quality of marketable plant products, as well as to quantify the mechanical properties of plant structures, improve mechanical harvesting, and identify the distribution of root systems. The circuit created as part of this research effort was used to produce acoustic music using the plants. With the aid of the 555 Timer IC, pulses were produced from discrete analogue signals, and these pulses were then processed to create acoustic music. Along with the light display on the circuit, waveforms were also produced in real time using Serial Plotter in the Arduino IDE programme. The life of plants is extraordinary. In order to communicate with other creatures, which was previously impossible, they needed a medium. This paper describes the development of a tiny step toward plant communication using Plant Bio Acoustics.

***Index Terms* – Bio Acoustic, Music, Plants.**

I. INTRODUCTION

The term "plant bio acoustics" describes how plants produce sound waves. Plants may perceive their environment and surrounds via sound. Some evidence suggests that when the cell walls crack, plants emit sound from the terminals of their roots. It is conceivable that plants can receive sound vibrations and translate them into messages to evoke BEHAVIORAL changes as a sort of underground communication since plant roots only react to sound waves at frequencies that correspond to waves created by the plant itself.

The plant world has a wide variety of instances of behavioral reactions. When their prey sits on the stimulus sensitive areas of the plant, the Pitcher Plant and Venus Fly Trap move. Another illustration of this is the semimonastic movement, in which the leaflets close in response to mechanical or electrical stimulation that includes touching, warming, blowing, and shaking. The touch-me-not plant, Mimosapudica, exhibits this kind of movement. All of these instances demonstrate that there is a response to stimuli, and it is possible that all plants would react to outside stimuli in a manner that humans would not fully comprehend.

This article comprises the theories, guiding concepts, and methodology for the Plant Bio Acoustics research project. The study is based on research which includes figuring out how plants behave. Waveforms and music are being used to represent these behavioral patterns. The interaction between the animal and plant kingdoms can be accomplished with the aid of such studies. This study also identifies plants that show emotion. This device was created to store the pristine sounds of nature, which are employed in yoga meditations as well as for relaxation when someone is stressed.

According to research findings cited in [1], plants communicate with one another to share information, just like people and other animals do. It appears that plants may notify one another about predators and prospective foes thanks to a special internal network. Similar to military defense, plants have an early warning system that is more effective since each component of the network may receive the external signal of oncoming herbivore danger and send it to the other members. The harmed leaf is destroyed. The leftover leaves are nevertheless secured against scavengers. Electrical signals were originally described in both plants and animals over 200 years ago, and they had become a significant area of study in plants over 140 years before. The majority of the older research included insect-trapping plants, which were the ideal study species for more than a century since they, like the sensitive plant Mimosa Pudica, produce highly quick and visually dramatic responses to contact. Electrical impulses, the sole known method for intercellular communication in any living system, were once widely believed to be shared by plants and animals. Darwin proposed the existence of chemical signals in plants, leading to the recognition that plants had both electrical and chemical signals, whereas mammals possess both electrical and chemical messages via hormones.

A stimulus is anything that causes the plant to react, and a signal is whatever the plant produces and sends out in reaction to the stimulus [2]. As a result, while the signal must originate inside the plant, the stimulus can come from outside. Furthermore, when a signal reaches its intended location and triggers a response, the signal itself turns into a stimulus.

According to earlier research, living plants can produce bioelectricity by using the photosynthetic process to convert sunlight into electricity [3]. This innovation has the potential to eliminate the need for fossil fuels and offer an endless source of reliable, clean energy. Choo & Dayou recently described some essential methods for harvesting weak power from living plants, including the choice of the harvester, the type of plants, and prospective applications.

Living plants can be used to generate electrical signals by causing a reaction between the plant and two distinct metals. It offers a green method to gather energy from sources that are widely accessible, which gives it enormous potential for sustainable energy generation. Previous research has demonstrated that the process of electrochemistry is responsible for its mechanism of energy production. This work models and illustrates the behavior of the ions flow in the electrodes-plant system [4].

The results of the literature review reveal that there has been little to no research on the production of acoustic music from plants. Because of this, everyone in the group felt motivated to embark on the endeavor of making music out of plants.

II. RESEARCH METHODOLOGY

Both hardware and software were needed for this task. The model consists of electronic parts such an Arduino Uno, a 555 timer integrated circuit, resistors, capacitors, Light Emitting Diodes (LED), electrodes, and a 3.5mm audio connection. With characteristics including signal sensitivity displayed in multi-color LEDs, an Arduino code is built in the Arduino IDE that converts electrical impulses from plants into pulses. On plants, the viability of electrodes was examined to ensure that we could achieve the desired output. With the help of a serial plotter, the waveforms that plants create in response to various stimuli were observed, and auditory music was played.

III. RESULTS AND DISCUSSION

The Zamioculas Zamiifolia plant, sometimes known as the ZZ plant, was used for this experiment. This indoor plant could respond to the smallest of touches by creating a waveform that could be observed. To get data from the plant, the TENS electrode was put into the soil as shown in Figure 1.

Figure 1: Electrodes inserted into the soil to make contact with the roots

The circuit activates and conduction begins as soon as the Arduino is linked to the computer system. The light display starts when the plant's leaf is touched, as seen in Figures 2 and 3, and pulses are transmitted from the roots to Arduino.

Figure 2: Before Impulse

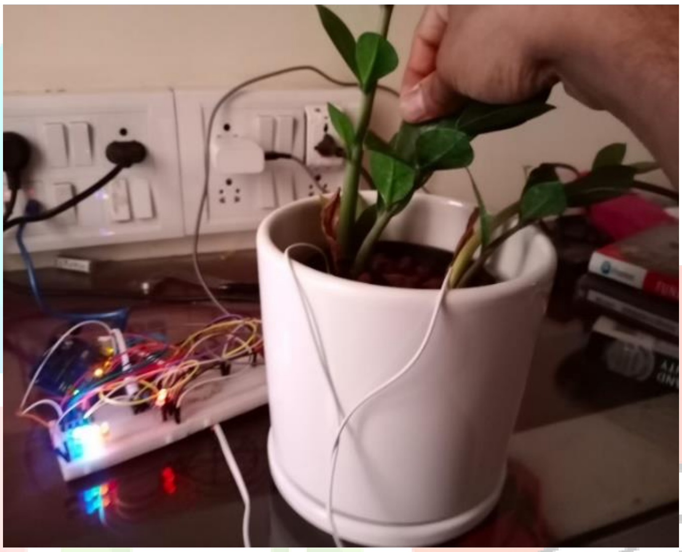

Figure 3: After Impulse (touch)

The waveforms of these impulses produced from the roots of the plats can be observed in the Serial Plotter of the Arduino IDE which is shown in the Figure 4. The same data can be observed in the form of bytes in python as shown in the Figure 5.

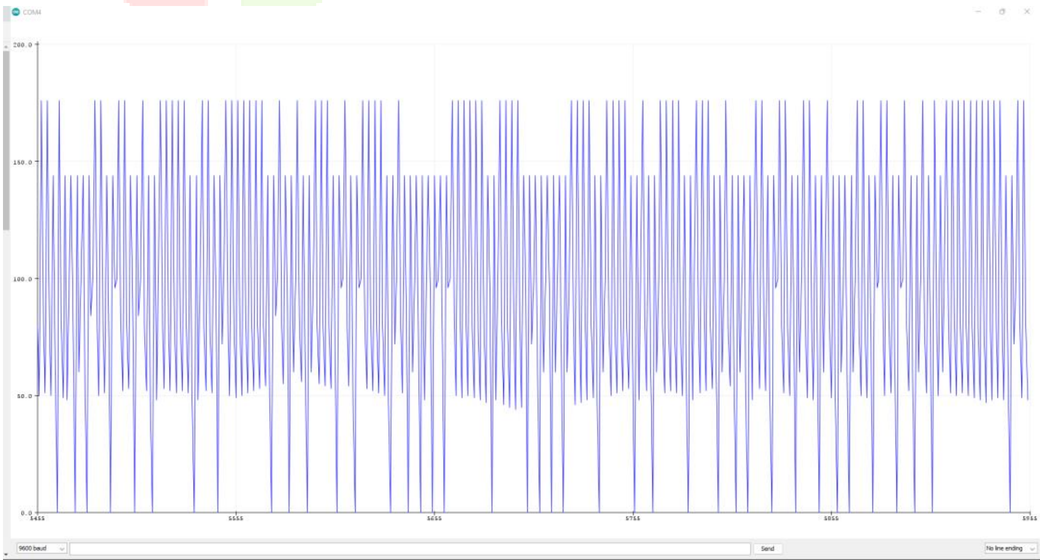

Figure 4: Impulses from the plant

Figure 5: The byte data that is being collected from the roots of the plant

IV. CONCLUSION

In response to biotic and abiotic constraints, plants have evolved a diversity of plant structures and cell walls with mechanical properties that are essential to the economy. Bio acoustic techniques have been used to measure the mechanical properties of plant structures, enhance mechanical harvesting, and map the distribution of root systems, as well as to monitor plant health, photosynthesis, ecology, and the quality of marketable plant products. The circuit developed as part of this research project was used to utilise the plants to create acoustic music. Pulses from discrete analogue signals were generated with the help of the 555 Timer IC, and these pulses were then processed to form acoustic music. Waveforms were also displayed on the circuit in addition to the light display.

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