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An electronic circuit development usingconducting botanical material (Plant Leaf) – A visionary concept

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ABSTRACT

A lot of research has been done on solid state electronics. On the other side, botanical research has been reached to a level where only limited scope is remaining. The upcoming reseach could be visualised which fills the gap between pure electronics and biology. Biotechnology provides a platform to apply the fundamentals of electronics on the biological conducting medium. Here, in this paper, the author has utilised conductng properties of plant leaf and tried to develop diffrential amplifier circuit.The response meets the desire output, which shows it is feasible to develop electronic circuits from different conducting botanical material.

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INTRODUCTION

The plants and their leaves are very good conductors. Their leaves, roots, stems and vascular structure are responsible for chemical signal transportation through them. From certain perspective these compositions could be visualised as conducting medium in order to form organic electronic discrete or analog circuits.Photosynthesis is responsible for proper functing and growth of the plants.Certain parts of the plants like leaves, veins, xylem and signals form the basic four componets of the circuit as the integral parts and templete of the circuit functions and elements[1]. The thermal conductivity is possible from the leaves of the apple tree. Anna Vaibare and his team has done a very good research on appe tree leaves. They represented thermal leave as a thermal insulation material[2]. All natural materials used for conduction are biodegradable which is the main positive aspect for selecting them for the same[3]. If the natural material could be utilised thermal insulation material than it will help to reduce the amount of remains and there by they will be rationally used. The lot of research has been done on coniferous tree needles from forestrey residues for thermal isolation material development[4]. Xiaotao Ding et al did research on diffenet leaves of the trees. They used the conduction property of the leaves. They gave different electrical conduction treatments to the similar leaves and observed their physical properties change. They noticed that certain low and high electrical conduction treatment clearly decreased plant dry weight, fresh weight, leaf size, leaf net photo synthetic rate, stomata conductance, transpiration rate and taste score[5].The amount of ions available to the plants in the root zone is directly related to the electrical conductivity of the nutrient solution[6]. The optimal electrical conductivity is very specific to the crop and varies with different environmental conditions[7, 8]. A lot of research has been done on the effects of nutrient solution electrical conductivity o leafy vegetable growth for example lettuce[9, 10]. So from the above literature it is very much confirmed that natural material like plants or leaves are very good conductors under certain conditions.

EXPERIMENTAL SECTION

For the aforesaid research, differential amplifier circuit has been chosen where output can be obtained from appropriate R and C configuration. The following figure 1 shows differential amplifier circuit. It is the combination of inverting and non-inverting amplifier.

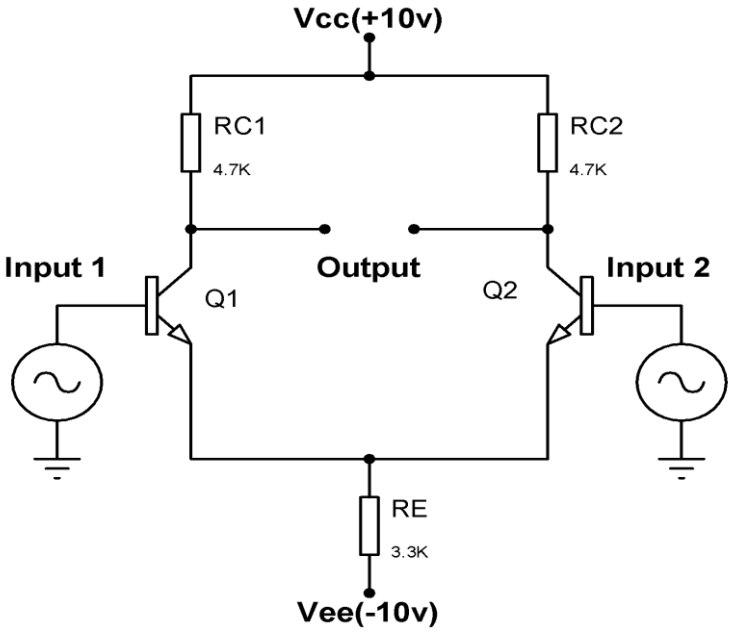

Fig. 1. Conventional differential amplifier circuit

The authors had done significant research on liquid based electronic circuits. In his research, transistor amplifier, astable multivibrator, diffrential amplifier and resistor-transistor logic circuits had been demonstrated using synthetic plasma liquid. Plasma liquid had been made in laboratories which has similar chemical composition like human blood. The aforesaid liquid electronic circuits had been analysed using different density liquids to get the stable general conclusion from the experiments. The response met the expectations which claims that liquid electronic circuit is feasible to design. Trees and their live parts are very good conductors so similar concept could be applied on conducting botanical material.After the successful efforts, the author has tuned his research to demonstrate similar kind of circuits using different conducting material. This time live plant leaf has been chosen as an conducting medium and sincere approach has been applied to conduct the research.

Figure 2 shows the visionary cocept of development of electronic circuit from a plant leaf.The authors did the similar experiment in laboratory.Here, different parts of plants have been used as various termials of the electronic components. The conventional inputs are given from function generators and DC power supply.The output is observed by Cathode Ray Osscilloscope. By close observation, it can be seen that big vein is utilised to form basic terminals(emmiter, base and collector) of transistor Q_1 and Q_2. Small veins are useful to demonstrate two terminal electronic component like Rc_1, Rc_2 and R_e.

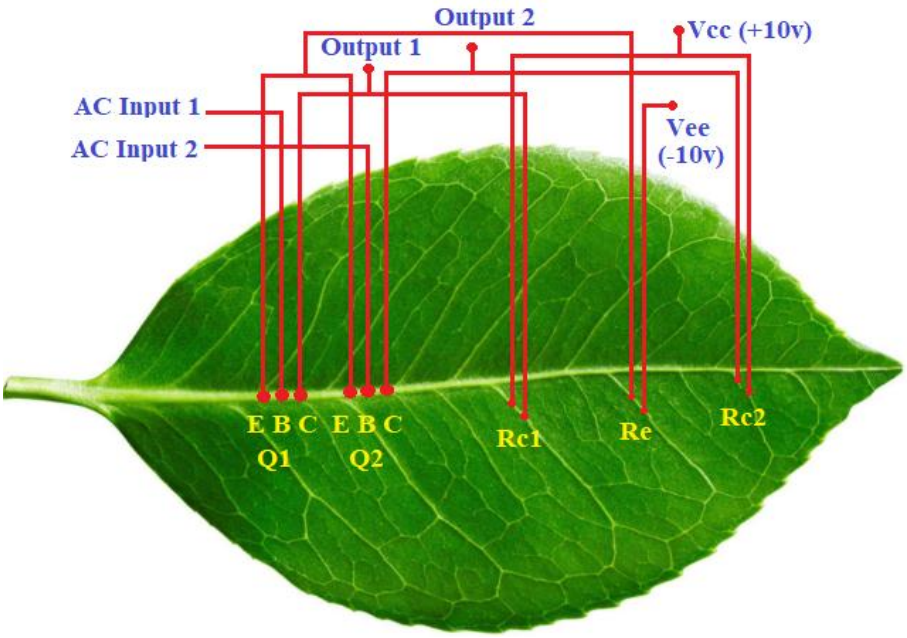

Fig.2. Experimental setup of differential amplifier from plant leaf

RESULTS AND DISCUSSION

The differential amplifier amplifies the differences between the two input voltages. It can be called as analog circuit with two similar frequency sinusoidal inputs and one sinusoidal output. Here, two inputs can be given as balanced input or one input is grounded to form a phase splitter circuit.

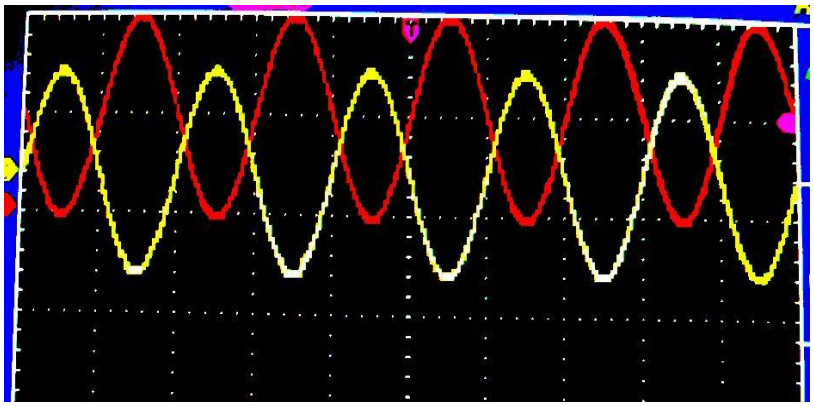

Fig. 3. Output from differential amplifier usingplant leaf

Figure 3 shows output of the proposed circuit if the input is in the form of AC sinusoidal voltage. Here also desired output can be achieved with 180^0phase shift. In the differential amplifier output, if it is not like a desired one then only one output from any of the collectors can be considered (by neglecting the other collector output). But in such a case, gain should be half of the desired one. This kind of output is called single ended output. To avoid this kind of gain, differential to single ended converter is utilized. Here output of the differential amplifier is not zero even though

both the input voltages are similar because of difference in gain but this is possible only for the ideal case.

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