Resistive Sensor Array Readout Circuit: Nodal Array Approach

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Abstract

In this paper, Nodal Array Approach (NAA) will be chosen in implementing readout circuit for pressurize touch sensor in hand grip application sensor array. We proposed a comparison methods of readout topology for resistive sensor array in terms of the circuit complexity, measurement error, and sensor capacity.

1. Introduction

A resistive sensor is an electromechanical device or transducer that transforms a mechanical change like displacement into an electrical signal that can be monitored after conditioning. Resistive sensor arrays are used in a wide range of applications, such as temperature sensor[1]–[3], pressure sensor[4], [5], foot plantar application[6], tactile sensor[7], [8] and gas sensor[9]–[11]. There are many sensor's reading techniques that has been developed in order to read all these sensors at once. The resistive-type pressure sensor produces the simplest form of array connection, known as a resistive sensor array[9].

The most effective approach to read a large number of sensors is to connect them all together in an array. In the conventional reading method, which is sometimes referred as 2-D scanning technique, the sensors are mapped out in the form of two-dimensional row and column matrices. By using switches, each row and column can be selected so that voltage value from a specific sensor can be read at a certain time. After that, the switches configuration needs to be changed in order to read other sensor one at a time, row by row, column by column until the last one. Timing is a crucial factor in obtaining the sensor's value. The major issue by using this conventional method is the crosstalk current occurs during the reading procedure[12], [13]. This happens due to the nature of this method that connects all the sensors in rows and columns array patterns. Even though a specific sensor has been selected to be read, the current can still flow freely into another row or column that contains other sensor.

This will result in inaccurate calculation of that selected sensor. Additional component such as multiplexer or transistor is added to the circuit in order to minimize the effects of this issue[14]. As for that, the circuit becomes complex and directly contributes to the increase of the circuit's power consumption and cost. Although there have been many research works in handling the crosstalk current issue, but the results only minimizing its effect, not eliminating it once and for all. Some research papers may claim that they have eliminate the crosstalk effect completely, but it is done by advancing the resistive sensor itself by modifying its material or component[15]. This will surely increase the cost of the whole system. Figure 1 shows the conventional scanning method to read resistive sensor array.

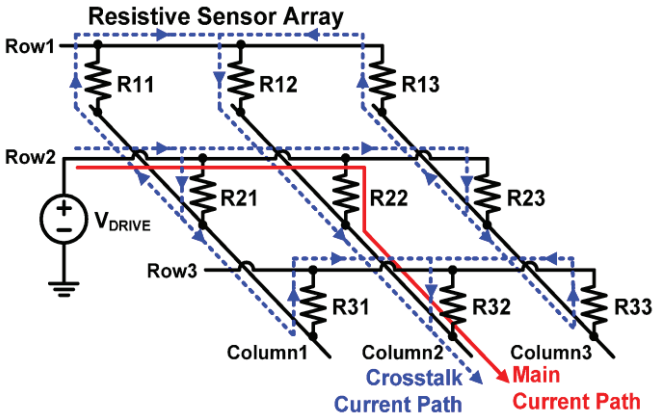

Fig. 1 Crosstalk currents occurrence in conventional scanning method [16]

This paper will first summarize the existing readout strategies for resistive sensor arrays and the advantages and disadvantages of each method used in published research. Subsequently, the discussion will introduce a Nodal Array Approach that an alternative to the currently existing method in reading resistive sensor array.

1.1 Resistive Sensor Array Readout Circuit.

1.1.1 Transistor/Diode Controlled Approach (TDCA)

In this approach, a transistor (or diode) is placed in series with each sensor to avoid crosstalk current between those sensors. A voltage or current source will be injected to a specific row and column port in order to read that particular sensor. In order to read all of these sensors in the array network, the source will be injected from row to row and column to column until the