



Researchers from the University of Bristol and University of Southampton collaborate to produce the first single-contact four-terminal relay for efficient digital logic

A team from the University of Bristol working on ZeroAMP, collaborating with the University of Southampton, has designed, fabricated and demonstrated the first single-contact, four-terminal relay that works in plane, to enable efficient digital logic circuits.

The principal investigator, Dr. Dinesh Pamunuwa, explained the significance of this work.

“Using tiny, nanoscale relays instead of transistors as digital switches allows us to place electronics in hot zones and radiation heavy environments where conventional electronics cannot operate. However, an individual relay typically occupies an area several times that of a transistor, which makes it challenging to build complex logic circuits without a large area penalty. One solution is to use switches that have four-terminals instead of three terminals, when the number of switches required is much less for a given logic function. Existing four-terminal relays, however, either require two or more contacts or have a complex out of plane architecture that limits their reliability. These existing switches are also typically much larger than three-terminal relays.

We have built and successfully tested the first single-contact, in-plane four-terminal relay to address these issues. In our latest work published in *Advanced Electronic Materials*, we demonstrate how this relay can be used to build a 1-to-2 demultiplexer circuit using only two relays, as opposed to the ten relays required for a three-terminal relay implementation. As our four-terminal relay occupies the same area as a three-terminal relay, this is a huge saving in overall area, and makes for much smaller chips. We also show how the technique of body biasing can be applied to reduce the voltage swing and energy consumption.

Our four-terminal relay is a very important building block in the demonstrators planned within the ZeroAMP project, and thus we are very pleased with this success.”

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