Novel Hybrid Circuit Assembly for Battery Free Smart Garments

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Summary

We present results of an investigation into the development of a manufacturing process for hybrid assemblies on smart garments. The objective of the work was to demonstrate the successful fabrication of complex circuits on fabrics based on Conductive Transfers' novel printed circuit technology. The battery free circuits aimed to provide capacitive touch control of a smartphone music streaming app. from the cuff of a runner's jacket. Successful assembly of NFC and capacitive touch controller ICs has been demonstrated. Software development and garment integration is required to complete a demonstration system.

Motivation

The ability to integrate electronic functionality into garments has applications in a wide range of markets including healthcare, wellbeing and sport. Conductive Transfers(CT) have a commercially proven screen printing process for the application of conducting tracks to a range of fabrics and are developing this hybrid process in partnership with CPI and IMEC to allow the addition of sophisticated electronics functionality to be added for sensing and other applications.

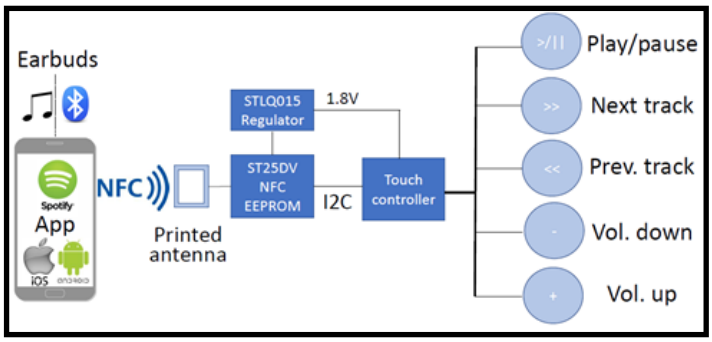

Figure 1. Hybrid circuit architecture including NFC & touch ICs

Architecture

Figure 1 shows the system and circuit architecture. The hybrid circuit has an NFC chip with a printed antenna. When a smartphone running a music streaming app. such as Spotify is placed next to the antenna in the running jacket pocket power is supplied to the circuit and a data connection is formed. Harvested energy is regulated and used to power a capacitive touch controller which is connected to the NFC chip over an I2C bus. Printed capacitive touch pads are used to control the music app.

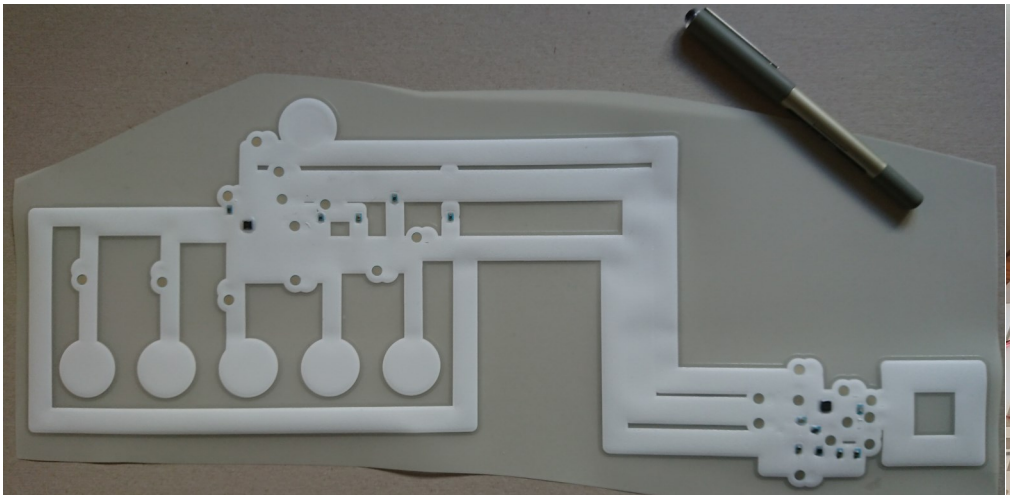

Figure 2. Hybrid circuit with assembled components including NFC chip (24QFN package)

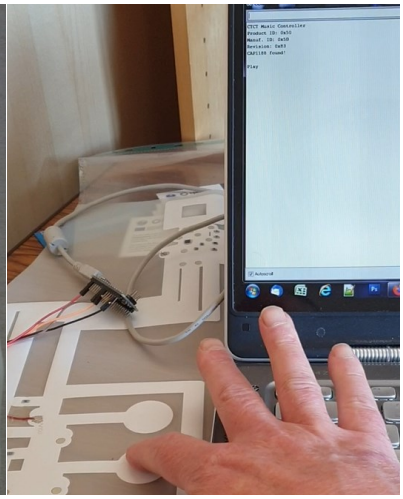

Figure 3. Testing touch controller

Results

IMEC carried out the schematic design of the circuit. CT prepared the circuit layout and screen printed the circuits onto PET sheets with a release coating. Two stretchable silver ink layers were used for the conducting layers together with encapsulating (white in Figures 2 & 3) inks to protect and isolate the conducting layers. An adhesive for bonding the circuit to textiles completes the ink stack. Conventional pick and place machines were used for assembly with anisotropic conductive adhesive followed by a syringe deposition of a textile adhesive around each components — see Figure 2. Initial testing revealed that an NFC app running on a smartphone was able to read the NFC chip and using an Arduino, connected to I2C bus test pads, capacitive touch functionality was demonstrated as shown in Figure 3. Software development and garment integration are future tasks.