Smart Wearable Antennas on Fabric Substrates

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Smart watches such as Fitbits and the Apple Watch have enabled real-time fitness tracking. These wearable devices market accounted for $14.5 billion in 2016 while the broader wearable technology market is expected to grow to $57 billion by 2022. Although these devices provide applications in industries such as healthcare, fitness and general use; demand for truly integrated wearables such as smart clothing has increased. Project Jacquard by Google ATAP produced the first smart jacket which when paired with a smartphone can answer/decline calls or activate voice functions via the user merely brushing their hand over one arm of the jacket. Nadi X yoga pants, with its integrated haptic feedback sensors can guide users to various exercise positions while also tracking progress. These smart wearable devices provide such features via integrated sensors. Embedded in sleek pockets of wearables, these sensors although wired together, can be removed for washing the clothing. Google's Jacquard in contrast uses conductive woven fibers to create capacitive sensors completely integrated into the clothing itself.

Research focused on developing integrated devices has produced antennas, RFID coding and various types of sensors integrated into wearable materials such as cotton or polyester. These devices (E-textile based), predominately manufactured via fiber weaving and conductive yarn embroidery yield nominal performance. Antennas designed and manufactured via fiber weaving and/or embroidery present a maximum accuracy of 21mm limiting high frequency applications. Furthermore, scalability of such devices also suffers due to complicated manufacturing processes deeming them expensive. In this study, we present a different approach on development of wearable type patch antenna fabricated via screen printing technique using commercially available conductive and non-conductive inks. Parametric analysis of conductive ink film thicknesses on fabric substrates vs conductivity will be presented along with comparison of embroidered/woven counterpart antennas. A link-budget analysis will also be presented.