# Amplifying Brain Waves to Control a Robot by Using Flexible Organic Transistor Circuits

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We demonstrate how the use of organic thin film transistors in a Pseudo-CMOS integrated circuit can effectively amplify alpha waves in the range of 8-12 Hz emitted by a brain to wirelessly control a robot. Modern electronics such as computer displays, smartphones, and sensors are rigid and made of inorganic materials. Using an organic semiconducting material instead allows the realization of flexible and stretchable electronics. Furthermore, organic materials can be solvent-based, leading to large surface area and low-cost inkjet printing to allow manufacturing scalability. Taking advantage of these properties, we integrated a flexible Pseudo-CMOS amplification circuit on a stretchable and flexible silver electrode to reduce noise and cross talk characteristic of crystalline based devices, attain large gain, and reduce cost by two orders of magnitude from industry standards. To demonstrate functionality, the electrode and amplification circuit was integrated with a custom wireless EEG (electroencephalogram) device to amplify alpha waves. Successful control of the robot paves the path for the development of other bio-signal detection devices. Sleep health can be monitored to optimize health and fitness, which is of increasing interest due to the 2020 Olympic Games in Tokyo. Alzheimer's and heart irregularities can be monitored at all times to provide urgent care and immediate response. A seamless internet infrastructure then emerges, allowing data to be collected from the physical world, sent to the cloud, processed, acted upon, instantly. Realizing this cyber-physical system is the intention of our work.



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