



Flying computers and life-saving smart phones: The magic of translational research

Imagine a world where flying battery-less wireless sensing computers that float like dandelion seeds are ubiquitous. Or a world where tiny origami shape-changing solar-powered microfliers help monitor pollution levels and airborne diseases. Or a robotic acoustic swarm that can isolate a specific person's speech in a room of hundreds who are all speaking at once. Imagine your smartphone being able to detect a fatal blood clot.

This is science fiction made fact.

These are just some of the inventions that Prof. Shyam Gollakota's lab is working on. Prof. Gollakota's work spans different domains of engineering and disciplines. Gollakota and his colleagues have developed several societally relevant devices using interdisciplinary methods. While origami microfliers and battery-less flying computers are exciting inventions, the most important ones use smartphones as affordable diagnostic tools.

As healthcare costs skyrocket around the world, there is a need for quick and affordable diagnostics. Gollakota's devices are helping millions of people to use computing tools for monitoring irregular heart rhythm, blood clots, testing for ear infections and hearing in newborns.

Cost-effective devices to detect hearing impairment in newborns become increasingly essential as WHO figures show that 5.3% of the world's population suffers from debilitating hearing loss. Much of this can be mitigated with early detection. Gollakota's lab devised low-cost wireless earbuds that can help screen for hearing impairment by detecting otoacoustic emissions which are

faint sounds emitted by the cochlea (a small spiral organ in the inner ear that converts sound waves into electrical impulses that the brain interprets as sound). The low-cost earbuds are combined with wireless sensing algorithms and help to identify the emissions and detect hearing problems.

Blood clots can be life-threatening. And for people who are on medicines like warfarin, frequent testing is essential. However, these tests can be expensive and wait times can be long. Prof. Gollakota's lab devised a way to use smartphones to detect blood clots. Their technique uses the vibration motor and camera on smartphones to track micro-mechanical movements of copper particles and to calculate frequent prothrombin time (PT) and international normalized ratio (INR) which will help determine blood clots.

Sleep apnea is a condition that affects millions around the world. It is a condition that leads to hypertension, diabetes, stroke and other conditions. Diagnosing sleep apnea can be an expensive and time-consuming process. The app invented by Gollakota's lab, uses smartphones to detect apnea events. They transformed a smartphone into an active sonar system that emits frequency-modulated sound signals and listens to their reflections. Gollakota and his colleagues developed algorithms that identify various sleep apnea events from these sonar reflections.

From flying computers and microfliers to smartphones as diagnostic tools, Prof. Gollakota's inventions run the gamut of translational research. These inventions will benefit people around the world for decades to come.