TeleDoc: A Smart RADAR-assisted Telehealth Monitoring System

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Abstract: This project aims to investigate a low-cost, portable, high-quality telehealth monitoring system that can 1) provide NASA a novel life support system to mitigate the highest risks to human health and performance to enable safe, reliable, and productive human space exploration and 2) deliver a promising solution that can enhance civilian access to public healthcare resources in emergencies like pandemics or inclement weather. Telemedicine is a key component of medical care on the International Space Station (ISS). In the early 1970s NASA partnered with papago (now Tohono O'odham) Nation of southern Arizona to establish the Space Technology Applied to the Rural Papago Advanced Healthcare (STARPAHC) project. In recent decades, NASA's sustained presence in space through programs like ISS as well as potential travel to an asteroid or other solar body telemedicine has remained an important priority for NASA. In January 2020 NASA successfully used a telehealth program to monitor the health of an astronaut who developed a blood clot during a six-month mission at the ISS. Meanwhile since late 2019 the highly infectious coronavirus has greatly stressed healthcare systems and entire nations around the globe. Telemedicine has become one of the most important tools to help with potential overcrowding and healthcare resource scarcity. Thus, the U.S. Department of Health and Human Services has encouraged healthcare providers to adapt and use healthcare to safely provide care to patients in appropriate situations. To deliver affordable high quality telemedicine to either astronauts or civilians effective health monitoring techniques are critical one major challenge is how to accurately measure and efficiently analyze human health through raw data collected by biometric sensors many federal agencies and research institutions NASA, AFRL, DARPA, Lawrence Berkeley National Lab are interested in related research, but there is still a gap between expectation and existing telehealth monitoring systems due to inconvenience of variable sensors and their limited adaptability to real time uncertain environments. To address this gap we propose a novel low-cost, contact-free, high-quality, radar-assisted telehealth monitoring system with artificial intelligence AI-on-the-chip. We propose to 1) develop a novel micro-Doppler RADAR that can effectively monitor human vital signs cardio-pulmonary activities; 2) develop a novel hybrid deep reinforcement learning based radar signal processing algorithm that can deliver real time health condition assessment using monitored vital signs develop a smart telehealth monitoring platform with AI on the chip that implements the developed RADAR system and hybrid deep learning based signal processing algorithm. We conduct real time experiments in different environments to validate the effectiveness and practicality of the developed scheme.