HARNESSING PHYSIOLOGICAL DATA FOR EARLY WARNING OF THREAT EXPOSURE

Population-based Fever Surveillance For Early Warning Of Infectious Disease Outbreaks.

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Currently, infectious disease outbreak events are only recognized when people start to feel acute symptoms of illness and begin showing up at clinics and hospital in unusually large numbers. By that time, the infectious disease has spread far and wide. However, there are two physiological events that manifest themselves earlier than severe illness. One is the immune system response (upregulation and secretion of cytokines into the bloodstream) and the other is fever. Stand-off body temperature measurement with infrared cameras has been widely used at transportation hubs starting in 2009 during the HiN1 pandemic. However, the selected camera technologies, image capture methods, and off-the-shelf software varied widely with ambiguous results as to their effectiveness. Sweat is an exudate of blood serum and has been shown to contain equivalent concentrations of cytokines as blood serum. Currently, there are no stand off technologies that can detect cytokines in sweat on skin.

To explore the potential for stand-off detection of immune response and fever for early warning of infectious disease, GTRI developed an optical platform consisting of a FLIR T1K IR camera (8 – 15 µm) and a Surface Optics SOC710 hyperspectral imager (Near IR, 0.4 – 1.0 µm) along with appropriate broad spectrum illumination. These optical technologies were matched with GTRI-developed facial location software to extract signals solely from the human face for hyperspectral, and the canthus region (lower inner eyes) for infrareds. This optical platform was used in an IRB-approved human subject clinical trial at Atlanta's Grady Memorial Hospital to image over 200 febrile and non-febrile patients. The infrared data will be used to calibrate and further develop and optimize the algorithm for stand-off body temperature measurement. The hyperspectral data will be analyzed for correlation with a number of other health metrics including body temperature, blood pressure, pulse rate, and blood oxygen level. Facial product use by test subjects will also be gathered for background subtraction.

These technology developments are not intended to diagnose fever in any single individual, but rather for medical surveillance. Such a system would monitor and establish the "normal" running average of fever incidence in any given population, such as at large DoD transportation hubs or aircraft carrier mess halls. Then to alert health officials when there is a significant increase in the fever incidence rate for follow on investigation. Such an early warning system would save lives by enabling earlier implementation of appropriate containment and medical countermeasure strategies. Another interesting application may be the ability to use facial recognition to match individuals with fever to travel itineraries to potentially determine geographic source attribution of the outbreak.

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