NONINVASIVE GLUCOSE MONITORING BY MID-INFRARED SELF-EMISSION METHOD

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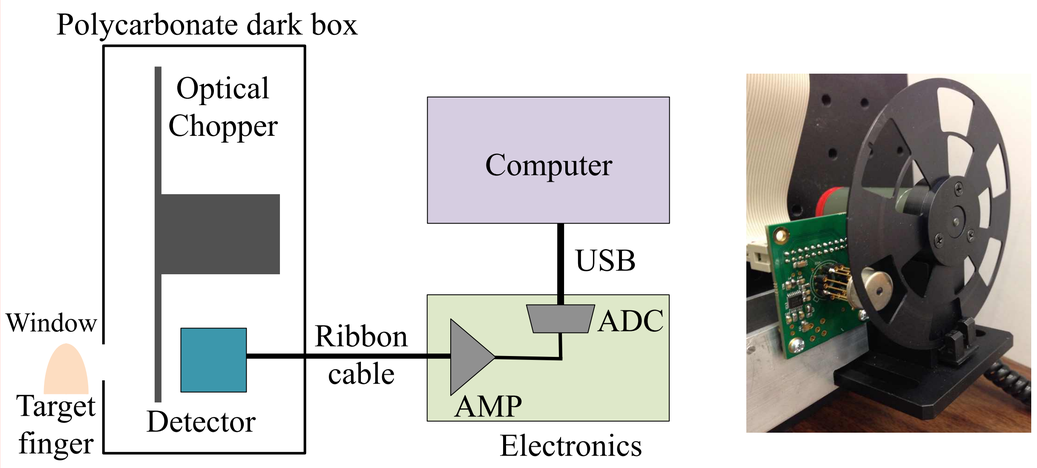
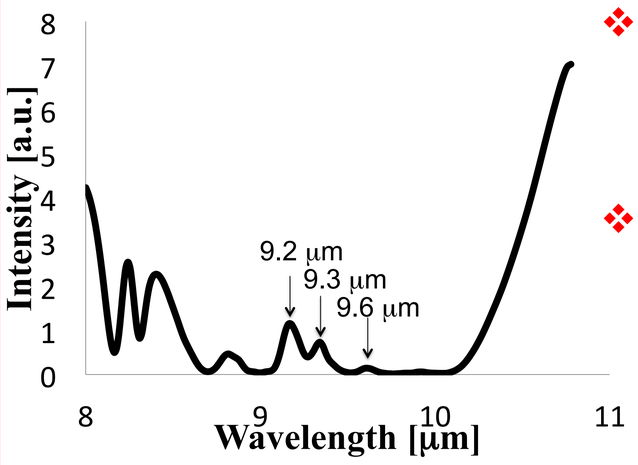
ABSTRACT

In this paper we present a non-invasive glucose monitoring technique which measures human body mid-infrared self-emission. The human body is a black body radiator that emits infrared radiation at a stable temperature; thus the human body is considered a continuous radiation energy source in the range. The fingerprint spectrum of glucose shows strong peaks between 8.5 μm and 10.4 μm, therefore, measuring the self-emission form human body in the mid-infrared range allows estimation of glucose concentration. Using a simple and miniaturizable design with a tunable Fabry-Perot filter (FPF) and a thermal detector, glucose concentration can be measured through the human skin.

EXPERIMENTAL

- Fabry-Perot filter (FPF) system



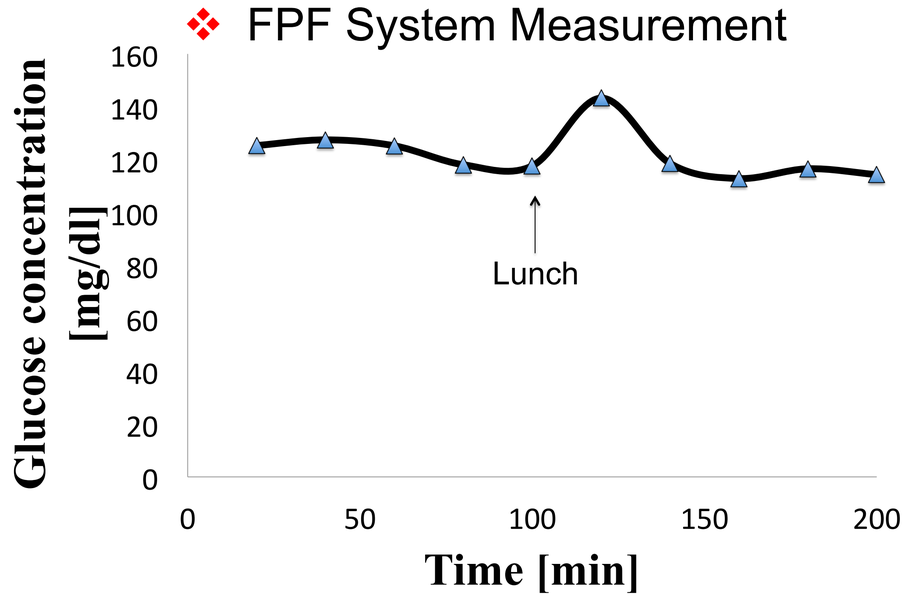


Glucose spectrum that were measured by FTIR spectroscopy.

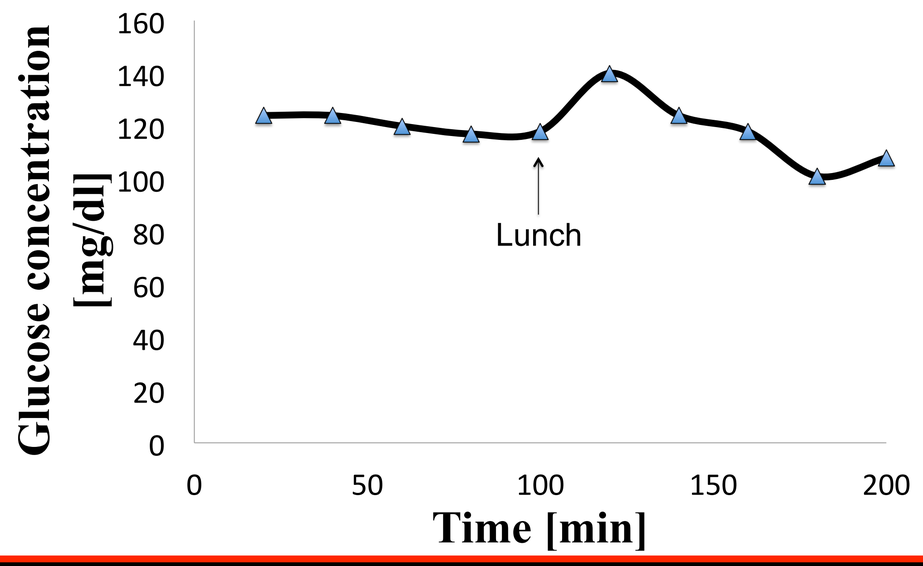
- The human body emits strong mid-infrared (MIR) radiation.
- Glucose molecules in the human body cause distinct absorption at their characteristic peaks.

GLUCOSE MEASUREMENT

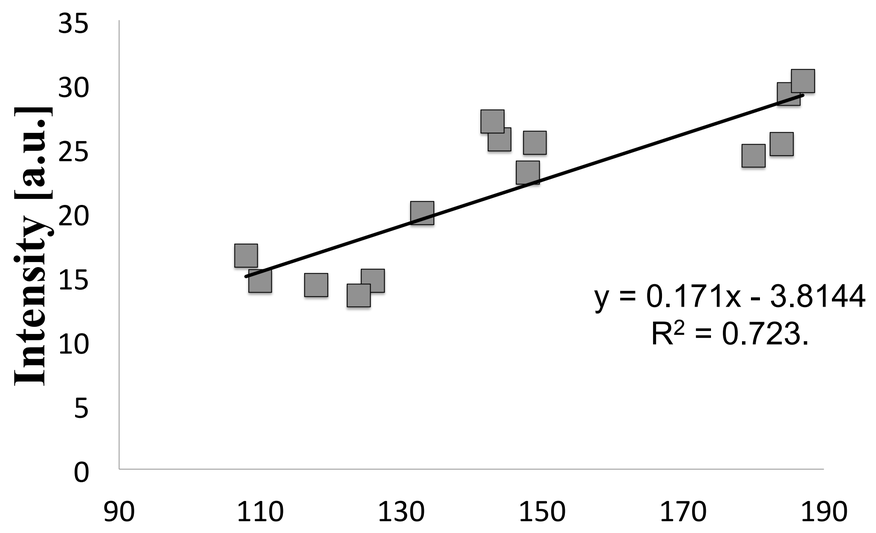
- FPF System Measurement



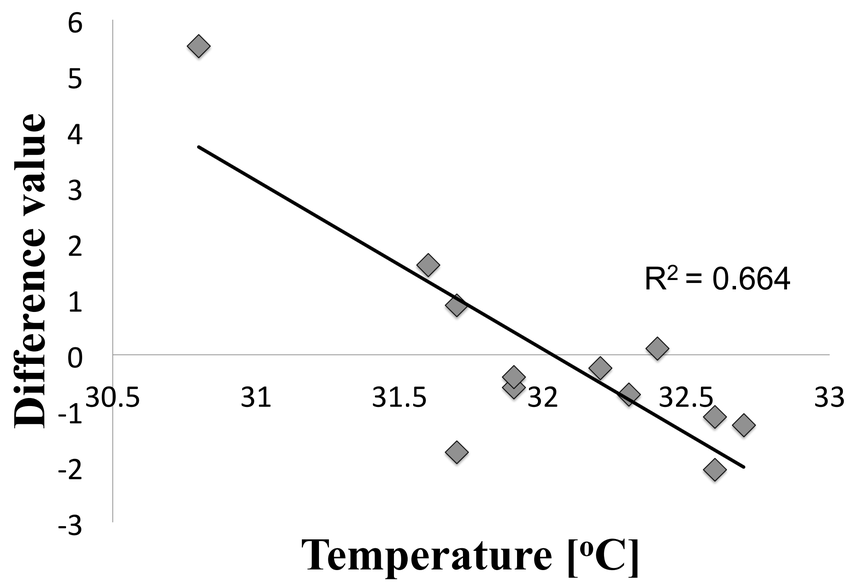
- Blood Test Meter Measurement



RESULTS



- The relationship between the intensity of the target's infrared radiation and real blood glucose concentration.



- The temperature of the target's skin affects the self-emission measurement.
- A larger difference between the trend line of intensity vs. glucose concentration and each measurement point was seen in a lower temperature region (temperature was measured by a thermopile).

CONCLUSION

- We measured the distinct band from the self-emission of the human body by FPF system; this allows the blood glucose concentration to be monitored.
- This non-invasive glucose measurement system allows patients to avoid the pain from stabbing their skin when they monitor their blood glucose concentration.
- The system still needs to calibrate several effects, such as the body temperature and ambient temperature.
- All the components in our setup can be fabricated on a little chip with a microelectromechanical system (MEMS).
- The final goal is to use this concept to build a complete non-invasive glucose monitor on a 1 x 1 cm chip.