Phoenix Project Lab Projects Background: Cuffless Non-invasive Blood Pressure Monitors

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The University of Minnesota Chronobiology Center determined that when blood pressure is monitored by an ambulatory (wearable) blood pressure monitor every half hour, day and night, for a week, six "Vascular Variability Disorders" (VVDs) can be detected. One of these disorders is a more precise definition of hypertension (high blood pressure) than is currently being used in mainstream healthcare; the others are still unknown or unused in mainstream healthcare. All of the VVDs, however, represent tangible risks of heart disease (#1 killer in U.S.), stroke (#3 killer in U.S.) and other health concerns. The Phoenix Project goal is the design of a blood pressure monitor that would enable bringing the use of VVD detection into everyday use in mainstream healthcare. Our student design projects will allow you to be a part of this groundbreaking endeavor.

Current methods for continuously monitoring blood pressure usually require the use of inflatable cuffs, pumps, and electronics similar to the automatic systems used in clinics and pharmacies. These devices are awkward, intrusive, and not conducive to being worn 24 hours a day for a week. The Phoenix Project mission is to design and construct a monitor system that would be comfortable enough to wear for 24 hours a day, cost effective enough to use at home, and robust enough to deploy on a very large scale.

One alternative concept to monitor blood pressure, Pulse Transit Time (PTT), has been proposed as described in the "Chen patent" (US Patent No. 6599251) to derive blood pressure from the timing of specific parts of the pulse waveforms. By recording a blood pressure pulse at two different distances from the heart, blood pressure can be determined by relating transit time between the two pulses using the equation: P=a+b*ln(T), where “P” is the pressure, “T” is transit time, and “a” and “b” are constants and are determined by correlating the cuff blood pressure to the transit time.

A second alternative concept, called Pulse Wave Analysis (PWA) or pulse decomposition, derives blood pressure from components of a single average pulse waveform and fluid dynamics relationships that are presumed to explain the components of the waveform.

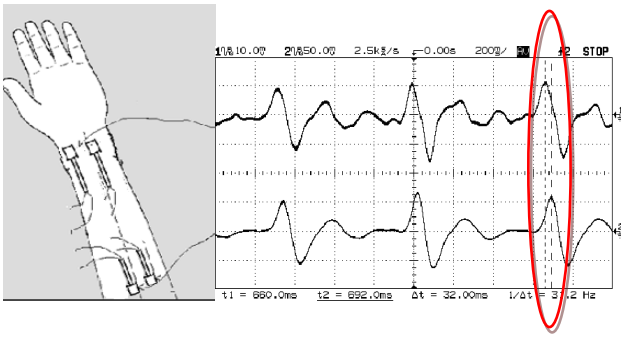

Fig 1. *An example of pulse propagation delay (pulse transit time) between forearm and wrist*

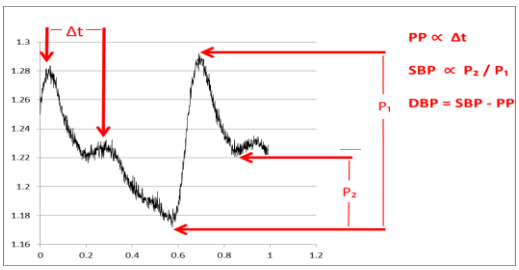

Fig 2. *Elements of one model used to derive blood pressure using pulse wave analysis*

Phoenix lab projects further analog sensor research and verify the alternative blood pressure monitor models that could underlie a future final design. They are primarily projects of sensor and associated analog circuit requirements development, design, and construction, followed by data collection and analysis. They are generally not digital microprocessor projects, though there is often a small software component that can be done in parallel to support the electronics work.

The Phoenix Project is completely open source; all information can be freely distributed, discussed with prospective employers, and included on résumés.