

A low-angle photograph of a firefighter in full brown and red gear, including a yellow helmet and a yellow air tank, climbing a white metal lattice tower. The background is a clear, bright blue sky.

EMPIRICAL TECHNOLOGIES

CORPORATE BROCHURE

Empirical Technologies Corporation envisions a future where personal health monitors are as universal as today's automotive sensors. Its technology will make a profound impact on the operational maintenance of human beings in all stages of life. By providing comfortable, low cost, highly versatile, and communications ready health monitors, Empirical's proprietary technology will dominate personal health diagnostics, patient monitoring, first responder activity, and athletic conditioning in the years to come.



MISSION:

Empirical's mission is to find simple and inexpensive technological solutions to difficult medical monitoring problems. We strive to discover novel devices that are as simple and universal as the paperclip. Our sensors allow continuous cardiopulmonary monitoring of people without discomfort or complicated equipment. We invent, research, develop, and prototype new devices, based on our technologies, and offer them for contract manufacturing and marketing, partnerships, direct licensing, or sale of enabling intellectual property.



PRIMARY GOALS AND VISION:

Empirical's goal is to become the world leader in personal cardiopulmonary evaluation by making its devices as available, effective, and inexpensive as a good bathroom scale.

We will provide the first blood pressure monitors that allow truly restful sleep.

Empirical will provide personal sleep monitors that monitor restfulness and allow the assessment of treatment strategies to aid sleep. We will provide blood pressure monitors that are comfortable and pain free, making white lab coat hypertension a remnant of the past. No other technology can monitor the heart rate and breathing rate of neonates without electrodes, which tear, infect, and otherwise damage the skin of these infants. No other technology can monitor the blood pressure of a baby without inserting a catheter into an artery. We intend to invent and perfect new devices that are critically needed, inexpensive, comfortable, and simple to use.



Supporting principles:

We strive to maintain a highly diverse staff and are dedicated to expanding expertise for the synergy necessary to invent the future. Our facilities, colleagues, and partners are carefully chosen to enhance our technologies, processes, and methods. Because Empirical is broadly based in several medical technologies, we offer the highest quality services anywhere. Our guiding principles are to down select prospective technologies that are amenable to inexpensive manufacturing, that are applicable to large singular or wide application based markets, and that meet an unmet need.



Values:

We are improving the quality of life.

Americans are frittering away their good health because of poor diets and sedentary life styles. Far too many children develop cardiovascular diseases because few are aware of simple physiological variables outside of weight and temperature. Type II diabetes, sometimes called adult onset diabetes and ordinarily restricted to older adults, is hitting US children hard.

One third of the US population is obese and another third is overweight, yet the vast majority of people do not understand the established link between cardiovascular fitness and weight. Empirical believes that the key to making people healthy is to provide them inexpensive tools to measure and assess their health. Our monitors will help people take control of their lives in an objective, affordable manner.

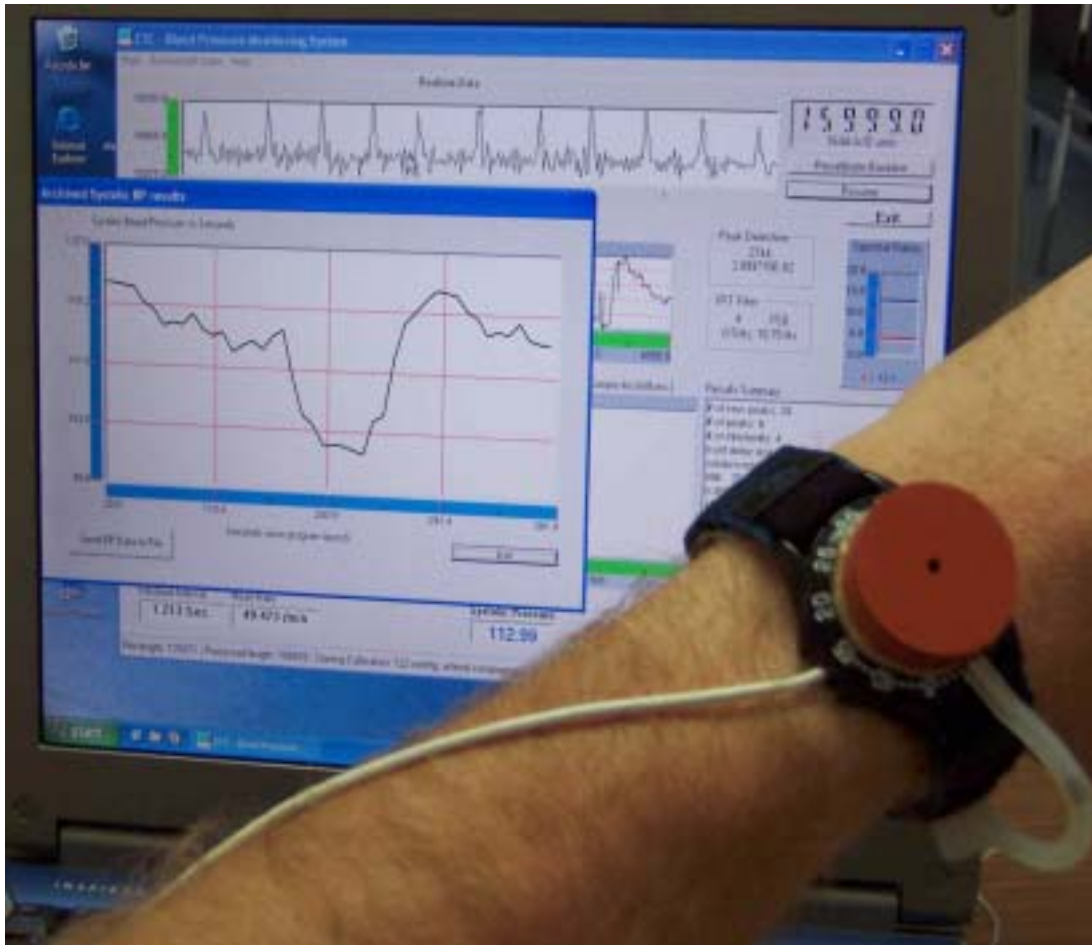
Products and Technologies

- **Physiological Status Monitoring devices for everyone**

The wrist has been called the beachfront property of the body. For physiological monitoring, the wrist is a particularly good site because (a) it does not get fat, which obscures cardiovascular signals and (b) because people are used to wearing wristwatches. Empirical's objective is to add, to a wrist watch, a stand alone physiological monitor that provides heart rate, breathing rate, blood pressure, and many other parameters which are available from a simple, comfortable sensor placed at the radial pulse.

Applications include asthma severity monitors and warning devices for children. Beat to beat regularity, heart rate variability, is a measure of fitness, but may also warn of impending sickness, fatigue, depression, or anxiety. There are no studies, which track the day-to-day variability, primarily because current technology makes this difficult or impossible. Empirical's wrist mounted sensor will allow the ambulatory monitoring of patients returning from heart and other highly invasive surgeries.





- **First Responder Platform for consequence management**

Empirical Technologies Corporation (ETC) has developed a non-occlusive systolic blood pressure tracker that also outputs heart rate, the two key physiological variables that are necessary for unambiguous determination of hemorrhagic shock and other life threatening conditions. Moreover, ETC's device is small and amenable to radio networking using available, off-the-shelf electronic building blocks.

Development proceeds for a demonstration which will monitor the state of health and GPS coordinates of first responders at distances of up to two miles. This funding has been provided by ONR as a Phase II SBIR, "Anti-Terrorism – Consequence Management and Recovery". The system is intended for monitoring both active first responders and monitoring potential casualties among them, monitoring during rescue attempts, monitoring after recovery, and for monitoring during hospitalization. ETC's system is primarily a device to increase the survival rate of traumatically injured casualties, while reducing the work load of medical personnel.

- **Sleep Monitoring**

The relationship of sleep deprivation and sleep disordered breathing to characteristics of the metabolic syndrome including obesity, high blood pressure, insulin resistance, and vascular inflammation is being pursued under major funding efforts by the NIH. The most effective way of measuring the restfulness of sleep is by monitoring the blood pressure continuously, however, there is no other way to do this without waking the subject. Empirical's blood pressure monitor is the first method, which will not wake the patient.

Applications as a screening device: the sleep monitor can diagnose and identify the types of sleep apnea and other sleep related problems. ETC envisions a cost well under a hundred dollars that would pre-screen patients before subjecting them to polysomnography, about \$1500 per session. Currently, only ten percent of patients referred for polysomnography are diagnosed with apnea; the remaining are sleeping restfully. Pre-screening, especially if government mandated, would save the US health system many millions of dollars per year and treat more people. Only about five percent of apnea sufferers are currently diagnosed.





- **Mattress Sensor that eliminates electrodes and their wires:**

Electrodes are presently the standard of care, but are themselves the cause of infections and skin tearing due to the sensitive nature of premature infant skin. Many infants of very low birth weight cannot use skin-based electrodes at all and must rely on pulse oximetry at the hand, which does not provide the respiration rate (RR). Home monitors for apnea of prematurity (AOP) also rely on electrodes and further require accurately positioned, carefully tightened chest belts, attention to electrical connections, and the hazard of wires bound to the infant.

Recent results, funded by the National Institute for Childhood Health and Human Development (NICHD) demonstrated a non contact infant monitor that senses RR and heart rate (HR) of infants confined to a neonatal intensive care unit (NICU) at the University of Virginia. Under follow on funding from the National Institute of Heart, Blood, and Lung (NHLBI), we are beginning tests of six mattresses monitors for infants weighing less than 1500g and six for infants near discharge, but suffering AOP. The latter will provide statistics on the likelihood of success for a home monitor, which would displace the current devices using electrodes. Two units will be installed in the birthing rooms for nearly instantaneous readings of heart and respiration rates. No current devices fill this need and satisfactory results are expected to create a new market of moderate size. The objective of this work is to eliminate ECG electrodes both in the NICU and at home. Because the mattress units are sensitive and selective to coughing, hiccups, apnea, and other cardio-respiratory events, these units will log information not currently available by any known device

Some Background on Empirical:

Empirical was formed by three scientist/engineers who began medical research after winning a DARPA TRP Phase I SBIR. This work transitioned to an Army Phase II SBIR (March, 1997) on another medical application, which used a fiber optic sensor for the sensing of heartbeat and respiration rate through very low frequency body movements or "infra-sounds". The device allowed a wristwatch sized device, to monitor soldiers or patients for vital signs. An antenna/transmitter module was added to the Army package for remote monitoring. The program is called "*Wrist Sensor for Warfighter Status Monitor*" and it was one of six projects selected by the Army for a quality award. A variation of the Army sensor is the *Smart Mattress*, a pad on which an infant or adult sleeps.

Numerous other awards from NIH and ONR and the realization of the size and certain growth of the markets resulted in an plan to exploit the unique sensing abilities of our technology. It was clear that DoD and NIH were looking for similar devices that would make medical monitoring safer, less expensive, less painful, more ambulatory, and more universal in general. It was also clear that our devices were being sought by researchers in other segments of the medical field. It also became quite clear that Empirical's solutions were tailor made for modern medical use in vital signs monitoring.

Throughout several intense years of research and engineering, intellectual property accumulated that was used to file numerous patents protecting the technology. We are now in the prototype phase and are seeking specific markets that would benefit from our devices and methods. We have partnered with British Technology Group and are working to develop applications and markets.



Core Competencies:

Empirical Technologies Corporation is a solution based, hardware oriented business that excels at emerging medical monitoring technologies. Its staff has extensive experience in the physical sciences, mathematical analysis, and engineering. We are primarily interested in innovative designs whose solutions push the state of the art in medical instrumentation. Our people have extensive backgrounds in manufacturing both prototypes and fully engineered products. Empirical works closely with physicians at the University of Virginia, Albert Einstein Clinic, and other institutions.

David W. Gerdt, Ph.D. is **president** of Empirical Technologies Corporation. Dr. Gerdt's primary responsibilities are to lead the strategic direction of the company while managing the day-to-day corporate operations. He also serves as principal investigator in several research and development programs funded by DoD and NIH. These efforts use several novel sensing methods for physiological monitoring to detect and analyze mechanical signals that the body produces that are strong indicators of health. Dr. Gerdt is directly involved in building personal sensor systems that give the wearer important information about their cardiovascular system. This technology is very new and opens the door to a broad range of devices, which are in great need by health conscious consumers. Dr. Gerdt is presently exploring marketing strategies, which would allow these technologies to be inexpensive enough for sale in drug or other retail outlets.

Martin Baruch, Ph.D. serves as **Chief Scientist** and is currently principal investigator for several grants from the National Institute of Aging and the National Heart, Lung, and Blood Institute. He is an officer of the corporation and contributes to strategies and long range plans. Dr. Baruch designs, tests, and models new systems and is primarily responsible for data analysis and interpretation, data presentation, physiological models development, program management and prototype testing of systems. Dr. Baruch is proficient in many computer languages and is responsible for writing programs and assuring successful software integration into our systems.

Charles M. Adkins, Ph.D. is **Chief Engineer** and is responsible for physical design, process development, and prototype manufacturing of physiological sensors and their supporting electronics. He is an officer of the corporation with significant background in engineering and manufacturing for a variety of programs related to physiological monitoring. Previously, as a Staff Engineer at Sperry Marine, he was the section head in the mechanical engineering group. Dr. Adkins has extensive background in electrical engineering and designs many of the circuits employed by Empirical. His expertise in systems engineering creates robust designs of important new devices based on the technology of Empirical.

Markets/Customers

British Technology Group International Inc.
University of Virginia Physics
CINEA
Newlife Technologies
Naval Research Laboratory
Seawall Group LLP
University of Virginia Cardiology
US Army Medical Research Acquisition Activity
Naval Underwater Warfare Center Newport
National Heart Lung and Blood Institute, NIH
National Institute of Aging, NIH
National Institute for Childhood Health and Human Development, NIH
Walter Reed Army Institute of Research
DARPA
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Tall Oaks Capital
Medical Automation Research Center
Applied Physics Laboratory Seattle
DVTI
Louisiana State University Chemistry
Metrotek Industries
Veridian Engineering
Pacific Sierra Research
East3
Harbor Branch Oceanographic
Old Dominion University Electrical Engineering
West End Anesthesia Group

Partnerships





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