

ABSTRACT

Bipolar disorder severely impacts an affected person's quality of life. It also imposes a high cost on society, causing financial strain on the affected and their support system. Bipolar patients, relative to the population at large, have greater numbers of mood fluctuations and greater numbers of severe mood states capable of developing into depressive or manic episodes. Even when properly diagnosed and treated, bipolar disorder can lead to death. Needed is a way to identify potentially dangerous mood changes early, enabling proactive and/or preemptive medical interventions. Often the first major episode for an individual who is bipolar happens between the ages of 16 and 25. College students are typically within the age group from 18 – 24 year old, which is in the middle of this statistical onset period. We propose to develop a mobile app for this demographic that will continuously monitor their mood and proactively alert healthcare providers of severe mood changes, enabling early and more timely interventions. The proposed innovation is the continuous analysis of voice characteristics to monitor the patient's mood, detect potentially significant changes, and proactively broadcast alerts to the relevant health professionals. This proposal focuses on cognitive science in general and bipolar disorder in particular, applying technical statistical analysis to biological functions in a social context. Preventive psychological health is still in its nascent stages. In the near term, the proposed mobile app will be developed specifically for bipolar individuals and as an open source tool for researchers and clinicians. In the long term, the app will be modified as required and marketed to the general population. People who have never had any mental health issues can monitor their mental states and moods for general health reasons. In addition, the proposed app is directly extensible to other mental health illnesses (e.g.; schizophrenia, unipolar depression, ODC, ADD, etc.). It is also extensible to related disorders, like PTSD. The proposed research and the knowledge gained will advance the use of voice analysis with a machine learning and human user data interface modality. This research and the mobile app will result in new ways to technically characterize voice data and model mental health. Patients, mental healthcare professionals and researchers will be beneficiaries of this work.

Specific Aims

Our specific aims establish the key objectives the Waveform Analytics team. Our specific aims are styled somewhat in chronological order although they interlink with each and all three are critical for the full utilization of our research plan and approach to help solve bipolar disorder.

Specific aim 1

The primary aim of our work is to develop accurate compound analysis on subjects' voice and compare that to their quantitative self-assessment scoring to our calculated voice based mood assessment. Voice characteristics indicate mood trends and we seek to develop an adaptive mathematical model to generate a summary mood score, our Mood Value Calculated Score (MVCS). Eventually, by using voice data alone, and after correlation with the user's qualitative assessments, plus integration with established mood-voice feature research, our mobile app will enable automatic mood determination using machine interpretation of voice features that are compiled to determine MVCS for the user. The establishment of our model involves the baseline characterization of control group subjects' voice-mood correlations. This baseline will be used to establish individualized voice feature characteristics mood offset for users and generate user specific baselines. The focus will be to characterize the individual's baseline and determine mood trending with a qualitative and quantitative synthesis of information. This data will be of key value to patients suffering from bipolar disorder and in the future other mental illness.

Milestones: 1) Develop machine-learning methods for analyzing voice features derived from using the openSmile or another similar API. 2) Integrate voice feature analysis with user self-assessment scores. 3) Prototype the app with a simple graphic user interface and get beta-test feedback and iterate until production.

Specific aim 2

College students will be our test group. The study group will be composed of 30 people from the "normal" population with no mental illness (including family history) and 30 subjects who are living with bipolar or at a high risk for onset of the illness. We seek validate the mood indication significance and efficacy of MVSC. Users response to the application (user experience feedback, A/B testing, etc.) will help us accomplish this aim.

Milestones: 1) Establish a detailed study plan. 2) Recruit study participants from local colleges. 3) Conduct the study successfully and demonstrate the efficacy of our approach to voice-mood correlations. 4) Prepare to submit for publication a separate and additional report focusing on the users and subjects' general behaviors and interactions with the app, such as: their opinions on the use of the self-assessment methods, additional type of information or features desired. We will include findings from doctors who will be testing our prototype.

Specific aim 3

A mobile app will be built that contains sophisticated voice analysis tools and composite feature models. The interface for users will be developed and deployed. A web and/or mobile interface for doctors to review patients' data will be prototyped as well. The mobile app for users will have a -3 to +3 mood assessment scale and the input will be done with a color/emoticon slider within the app. In addition, graphical charts will show the users history of mood and sleep. Both the qualitative self-assessment scores from the user and also the quantitative machine learning interpretation of voice and user self-assessment will generate the adaptive MVCS value which may be shown to users on the home screen or detail screen within the mobile app. Successful completion of this aim will demonstrate the efficacy of our app for clinical applications.

Milestones: 1) Finish building a fully production ready application. 2) Provide clear and useful data to users and their doctor's. 3) Establish the efficacy of the technology for clinical use.

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26. Additional References (3 are cited): The below are a selection of recently awarded SBIR Phase I proposals (2014-2016), from searches at NIH RePORT for the terms - mobile app, mental health and bipolar disorder; with the filters - new, SBIR/STTP:
 - 26.1. ACCURATE WIFI-BASED LOCALIZATION OF DEMENTIA PATIENTS FOR CAREGIVER SUPPORT; ASTER LABS, INC.; SHEIKH, SUNEEL ISMAIL; Total Cost by IC \$194,366
 - 26.2. DEVELOPMENT AND TESTING OF A BEHAVIORAL ACTIVATION MOBILE THERAPY FOR ELEVATED DEPRESSIVE SYMPTOMS; MOUNTAINPASS TECHNOLOGY, LLC; LEJUEZ, CARL W; Total Cost by IC \$224,573
 - 26.3. FORMATIVE RESEARCH FOR MOBILE APP PROMOTING SEXUAL HEALTH FOR YOUNG BLACK MEN WHO HAVE SEX WITH MEN (PSH4YBMSM); DFUSION, INC.; KUHN, TAMARA J et al.; Total Cost by IC \$224,838
 - 26.4. NOVEL USE OF EMERGENT TECHNOLOGIES TO IMPROVE EFFICIENCY OF ANIMAL MODEL RESEARCH; ROCKSTEP SOLUTIONS, INC.; DONNELLY, CHARLES J; Total Cost by IC \$224,870
 - 26.5. WEARABLE DEVICE TO MONITOR BLOOD ALCOHOL LEVELS IN REAL TIME; LYNNTech, INC.; DUNHAM, HARDIN RUSSELL; Total Cost by IC \$225,000
 - 26.6. SCREENING TOOL FOR PEDIATRIC BIPOLAR DISORDER IN PRIMARY CARE; 3-C INSTITUTE FOR SOCIAL DEVELOPMENT; DEROSIER, MELISSA E.et al.; Total Cost by IC \$217,483

- 26.7. LOCATION INITIATED INDIVIDUALIZED TEXTS FOR AFRICAN AMERICAN ADOLESCENT HEALTH; MEI RESEARCH, LTD; WOOLFORD, SUSAN; Total Cost by IC \$149,940
- 26.8. MOBILE INTERVENTION TO ENHANCE PHYSICAL ACTIVITY IN THE CHRONICALLY ILL; OREGON CENTER FOR APPLIED SCIENCE, INC.; BIRNEY, AMELIA J; Total Cost by IC \$223,704
- 26.9. A TOOL FOR RESEARCH ON EMOTION IN NATURALLY OCCURRING SPEECH; CONVERSPEECH, LLC; CRANGLE, COLLEEN ELIZABETH et al.; Total Cost by IC \$225,000

Leadership Plan

Overview of principle investigator responsibilities:

PI#1 and PI#2 will provide oversight of the entire project and the implementation of processes and procedures related to development of our SALUTEM™ mobile app. PI#1 will be responsible for the technical development, software implementations, and specific aim #1. Both PI#1 and PI#2 will be jointly responsible for specific aim #2. PI#2 will be responsible for specific aim #3. Regarding, specific aim #2, PI#1 will be responsible for the science and technology development, while PI#2 will be responsible for ensuring usability on individuals' mobile devices who participate in our study. Waveform Analytics' intragroup project management and tasking software will be the online project management tools such as Github, and Trello or Dapulse. Standard face to face meetings, web/phone teleconferences, company email, and instant messaging will be utilized as well to facilitate a drive toward completion of the specific aims. Weekly or bi-weekly all-hands meetings will be held to make sure all objectives are within cost constraints and on schedule. For conflict resolutions, including financial matters, the PIs will seek the advice of Mike Bowles (our advisor) and he will make deciding vote to move forward with one PI's plan or more likely architect a compromise. The PIs will share in oversight of the product, research, infrastructure required to succeed.

PI#1 direct responsibilities:

- **The scientific direction and technology development:**
 - Mathematics of linguistics and algorithmic interpretation
 - Signal processing methods and development of the M_{VCS}
- **Designing and directing the research plan:**
 - Bipolar, at risk for Bipolar, and control study group (college students)
 - Data acquisition, processing and analysis
 - Correlation research between control (no mental health history or family history of mental illness) baseline voice feature coefficients.
 - Characterization of relationships between user self-assessment values (continuously recorded) on the integer mood choice system from -3 to +3. The user choices being to choose one of seven mood ratings for their current mood. Where the qualitative rating choices are one of the seven integers from the set = $\{-3, -2, -1, 0, +1, +2, +3\}$. The graph of user-assessment values vs. voice characteristics will be correlated and relationships established to help determine how voice and user-assessments correlate.
 - Responsible for development of the M_{VCS} adaptive linear equation.

- Machine Learning feedback loop to adjust the baseline of the control population and the individuals under study (Bipolar or at risk for Bipolar) by determining voice feature extraction weighting values and nominal mood baseline indicators vs. positive or negative mood indicators.

PI#2 direct responsibilities:

- Administration and coordination of the Project
- Prototype, design, user experience, usability and project management of beta app development
- The timeline and schedule of the project: technology development, testing, coordinating the organization and research trials.
- Ensure that procedures and quality systems are in place for compliance with USA and California laws including NIH, FDA and other government entity stakeholders.
- Human test subjects guidelines that the research trial will require. Oversees that data management and interactions with the test group complies with Exemption 4 of the Federal guideline 46.101(b) (2). This will include ensuring security and privacy features in to the app and servers are sufficient and HIPPA compliant.
- Long-term project management commercialization of the mobile application including monetization plans and services offered by the mobile application.
- Fiscal and administrative management, including allocations of the award budget, after agreement with the PI#1 and Mike Bowles, our Advisor and Chief Scientist.

Further Responsibilities of the Principle Investigators:

PI#1 will be responsible for seeking technical, academic, and psychiatric doctor as advisors. Moreover, he will establish contact with national and local psychiatric associations (such as NAMI). Additionally, he will consult with individual psychological health care professionals within his own psychiatric care network. Mental health providers will be surveyed to get feedback on the application's efficacy for incorporation into modern medical practice. The goal of the app is to enable preventative consultation/medication mitigation of mental health crisis in the bipolar patient population by allowing the care providers a warning and opportunity to reach out to the at risk patient. The medical community will observe that proper use of the app results in lower suicide rates and the financial/personal destruction that can be caused during patients' depressive and manic episodes.

PI#2 will be responsible for communication with NIH and serve as contact PI and the submission of progress reports and deliverable to NIH in the event that a grant for our work is awarded.

Intellectual Property determination:

PI#1 and PI#2 will be responsible for preparing and negotiating agreement(s) for any intellectual property and any application(s) to the US Patent and Trademark Office and/or the World Intellectual Property Organization. In general all intellectual property will be assigned to the company.

Publication authorship will be based on the relative contributions of the PIs, advisors, consultants and key personnel.

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Facility

The Hacker Dojo is a convenient and resource rich, and inexpensive co-working hacker/maker space. Its location is central to the Silicon Valley technology community.

It is approximately 10 to 30 minutes driving distance of several large universities such as: Stanford University, UC Berkeley, Carnegie Mellon University – Silicon Valley Campus, San Jose University, Santa Clara University, and Sofia University.

Our current plan is to continue at this facility. However, if we need to relocate there are several other office and co-working spaces within few minutes of our current location. We do not have special facility requirements. Meetings and interviews with study group subjects will be held at this facility, on campus and other meeting sites. All our research and study group data will be stored encrypted in our computers or in the cloud.

Location:

- Hacker Dojo, 599 Fairchild Drive, Mountain View, CA 94043

General Description:

- Hacker Dojo is a co-working membership owned and operated non-profit hacker/maker space and organization.
- Several meetups, classes and events are based here – for example: machine learning and data science, IoT, programming, product management, startup legal and patent regulation.
- Sponsored hackathons are held periodically.
- Approximately, 400 members.
- Approximately 17,000 SF total, single story, consisting of: +/- 8,000 SF open seating/desk area, 98 maximum capacity event space, 5 room for private meetings and classroom, 1,000 SF maker space, and kitchen.
- Monthly dues are \$200 for 24/7 access for open seating.
- Separate, enclosed, secure, dedicated desk and work area is available at the rate of \$350 per month.

Hacker Dojo Trivia:

- Pinterest founders first met here.
- Pebble Watch was founded here and launched their first Kickstarter campaign (raised \$10 million).

Budget Justification

The award request: \$222,200.00

A. Senior/Key Persons.....128,700.00

- Jonathan Voelm, Michael Chung, and Melanie Minor will work full time for six months
- Mike Bowles will advise and work throughout the project period and the total work days is estimated to be at least 1 full month

All the Senior/Key Persons will have equity/ownership in the business.

B. Other Personnel.....59,000.00

Mobile app developer:

- One mobile app developer will be hired and available for the duration of the project, equity in the business may be additionally offered.

System: architect, developer, administration:

- One senior system developer will be hired and available for the duration of the project, equity in the business may be additionally offered.

Junior system developer, support:

- One junior system developer will be hired and available for the duration of the project, equity in the business may be additionally offered.

Interns - students or recent graduates:

- Three interns will be hired to assist with the project; and shall assist to liason, supervise and encourage approximately 20 test group subjects each.

F. Other Direct Costs.....34,500.00

- Materials and Supplies: Study group meetings supplies, food, etc.; research and test preparation supplies; misc.
- Equipment or Facility Rental/User Fees: Rent for office space
- Software, computers, other hardware; devices/app usability testing, user analytics: Included are development software, smartphone devices, armbands/holsters for test subjects for their smartphones (to better capture voice sounds), testing the app for bugs on several popular smartphone devices, third party app usage analytics to track crash reports and feedback, etc.
- Remuneration/stipend for study group, 60 college students, average 6 weeks, \$300 each: This is approximate compensation to the participants of the study group. One half of the group will be in the research test for approximately 10 weeks, and the other set for 5 weeks.
- Legal and mental health professional consulting: We will consult lawyers for the consent forms for the study group. We will also consult with mental health doctors.

APPLICANT BIOGRAPHICAL SKETCH**APPLICANT BIOGRAPHICAL SKETCH****NAME OF APPLICANT:** Michael Chung**eRA COMMONS USER NAME:** waveformmc; waveformmcp**POSITION TITLE:** Product, Marketing and Business Strategist**EDUCATION/TRAINING**

INSTITUTION AND LOCATION	DEGREE (if applicable)	START DATE	END DATE	FIELD OF STUDY
Baruch College, City University of New York	(Freshman)	08/1977	05/1978	General Education
New York University (New York)	B.A.	08/1978	05/1982	Political Science; Philosophy (minor)
Mercy College Masters of Science in Direct Marketing (New York)	(Cont. Ed.)	08/2006	04/2007	Direct Marketing
Hofstra University (New York)	(Cont. Ed.)	08/2010	05/2012	Intro Healthcare IT; Healthcare Security and Processes; Ecommerce; Applied Cryptography and Encryption; Info Systems for Managers

A. Personal Statement

I have experience and training to direct and guide the strategy and design of the user interface and experience for the mobile application solution. With experience in rapid prototyping and lean development I can drive this project forward a rapid pace. My recent consulting experience includes working with interns, promoting, surveying, and meeting one-on-one with college students at USC and San Jose State University to promote, acquire users, and test the value proposition for a video chat mobile app.

As co-PI, my areas of responsibility will include the strategy and design of the mobile application's UI/UX. We will benchmark against the related top consumer apps, and aim to improve on the state of the art healthcare/clinical mobile application practices. Waveform Analytics' vision and value proposition were originated by Jonathan Voelm, the founder and co-PI. I have acted as counterpoint and added meaningful new This document is private. It contains confidential and privileged information. It is not for public viewing. Do not disseminate. © 2016

materials. We meet at a hacker-maker space called “Hacker Dojo” in Mountain View, CA and we have access to a deep and uniquely varied pool of people and resources.

With three decades of experience in diverse industries, I can help the younger members of the Waveform Analytics team to anticipate challenges such as: usability barriers, user adoption, and commercialization. Our mission includes to advance the art and science of using voice analysis with the latest advances and innovations - from machine learning, data science, smart wearable body sensors - for patient self-assessment and monitoring. I have expertise in technology, security and adoption aspects of healthcare solutions and knowledgeable of the industry challenges such as: interoperability of data, exchange and sharing of data, technical usability issues, privacy and security systems and maintenance, and solutions compatibility. I am also aware of the business and professional adoption barriers that may concern physicians if this technology is to be incorporated as standard medical practice and know that bringing innovation from the lab to the market takes time and balancing needs and desires of the healthcare services providers. To sustainably introduce a new product requires addressing the business needs of the potential solution providers and their respective protocols. I will help Waveform Analytics to be mindful of these future technical and commercialization factors as the mobile application is being developed and our hypothesis is tested.

As an entrepreneur, I have managed several retail businesses and have skills in leadership, project management, budgeting and business compliance. For example, for a 2 year period in 2004-2006, while working in the NY metro area, I helped the US General Service Administration procure office spaces for their client agencies and out produced the national real estate firms that had dozens to 100s of professionals in their employ.

After success in real estate and general business, I began to seek challenges and successful ventures in the technology sector and that has been my focus for the past few years. This exciting proposal addresses important public health needs and can greatly help at risk patients with mood related mental illness. With new approaches my co-PI and I will complement each other’s skills, experience and executive knowledge. The result will be a successful Phase I completion with outstanding deliverable.

Community/Organizations

1993-1995	Member, Lions Club, Flushing, New York
1998-2005	Member, Boy Scouts of America, Troop 1, Flushing, New York

Patents Published

1. Methods and systems for electronic mail, internet target and direct marketing, and electronic mail banner. Priority date: March 22, 2001; Inventor: Michael Chung. (Remarks: Referenced or cited by over 200 patents/applications.)
2. Method and System for Managing Folders of Email Accounts and Voice Messages. Priority Oct. 4, 2004; Inventor: Michael Chung.

B. Positions and Honors

Positions, Employment

San Francisco – Technology and Mobile Apps

2013- Consultant (Marketing and Product Development), Chatgame.me

Projects:

- 2013, ShoutFi.com (Location based wall for places)

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- 2015, ChatJoi.com (Live video streaming combined with video chat)
- 2015, MoneyJoi.com (Personal budget manager; Folders in lieu of additional accounts (patent pending))
- 2000-2015, Mailram.com (Smart-Email and Encryption Solution)

New York – Real estate, Marketing, Retail and Online

2012-2013 Technology: Self – training, education and research

2011-2011 Manager and Supervisor, Food Gallery 32, largest food court in New York City.

2010-2011 Marketing Director, Bogopa Corp., Food Bazaar Supermarkets (Remarks: 3,000 employees, private ownership, 15 locations)

2000-2010 Own startups in ecommerce, messaging and encrypted email

- 2008-2009, WeBunch.com (A Groupon inspired - group buying model)
- 2003-2005, Rackr.com (A new concept and process for recipients to pull email(s) vs push)
- 2003-2004, ToFone.com (Combining the country code plus the local phone number to result in a universally unique and published ID – in lieu of their email address.)
- 2000-2003, eBunch.com / MyBunch.com (Price dropped as more people ordered/buy)

1983-2010 Self-employed or Consultant – Real estate, retail, sales

- 2001-2007, Owner, Mcvest Realty Co., commercial real estate development (Remarks: During 2004-2006, was a top producer nationally in office space procurement RFPs for one of the client agencies of the US General Services Administration.)
- 1996-2001, Associate Broker and Principal, Metrovest Equities Inc., sales and development; dealing in non-performing assets and property rehabilitations
- 1993, Electronic Transaction Corp. (Remarks: Mashed together one of the first wireless credit card authorization/reader system (using Motorola radiophones) and did a pilot project with an agency of NYC for use in their vehicles)
- 1991-1996, Owner and President, Landow Corp., small business financing and retail merchant services and real estate services
- 1983-1991, Began real estate profession as salesman; progressing to associate broker

Other Experience

2014-current Hacker Dojo, Mt. View, CA: Member, software and technology hacker-maker organization

C. Contribution to Science

Not applicable.

D. Research Support

Not applicable.

APPLICANT BIOGRAPHICAL SKETCH

NAME OF APPLICANT: Jonathan C. Voelm

eRA COMMONS USER NAME: waveformjv, waveformjvpi

POSITION TITLE: Lead Scientific PI, Executive

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	START DATE	END DATE	FIELD OF STUDY
American River Community College, Sacramento, CA	(none)	09/2000	12/2001	Calculus 1, 2, 3 and some general ED
University of California, Berkeley	B.S.	01/2002	05/2006	Electrical Engineering & Computer Science

A. Personal Statement

As the lead principle investigator, my responsibility for developing the science and technologies needed to achieve our objective is clear. Creation of a mobile application that tracks mood through qualitative self-assessment and quantitative voice waveform characteristic analysis will allow for superior care in the mental health field generally and specifically for those suffering from Bipolar Disorder. I have lived with Bipolar and through 3-4 episodic cycles have been able to identify how to effectively self-monitor and what to lookout for that could signal the onset of, or active major episode (manic or depressive). When seeking a mobile application to replace the paper mood chart I was unable to find an app that was better than my paper charting. I thought that using a mobile app for charting would be a great solution and was surprised when there were no truly “good” applications available.

In order to help all those suffering from bipolar disorder, Michael Chung and I formed a team of resourceful, creative and intelligent people to work with us to build a mood tracking application that is better than the paper charts. I still write on paper charts by hand to this day and can’t wait to deploy and test our proposed app.

Although my scientific background is officially in the electrical engineering and computer science fields I have also taken coursework at UC Berkeley on inorganic and organic chemistry, biology and bioengineering, and philosophy. My general love for science and engineering has empowered me to venture forward and attempt to create a partial solution to mental illness through biological behavioral modeling for monitoring mood and mental health risks in real time.

My favorite class in college was titled “Transducers”. The lab experiences and knowledge gained related to energy transfer and its relationship to both power and information movement through different medians was essential to preparing me to take on this work. Analyzing digitized analog signals with statistical methods and then compressing that raw data into meaningful conclusions is my passion.

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While, fundamental research and development processes as an independent agent (nascent startup) are lacking from my experiences as an enthusiastic 32 year old, I am, however, a scientist who lives with this problem everyday and have spent many years studying the disorder. Through investigating what triggers and indicators are present for myself and others suffering I have gathered lots of data in my mind about the environmental and mental feedback involved in the manifestation of major episodes. It is necessary for me to perform this work to help everyone mitigate the dangerous effects of extreme mood episodes. I will apply all of my interdisciplinary insights from physics, chemistry and biology toward advancing care for mental health in the service of society.

B. Positions and Honors

Current Employment

2007-2013 &

2014-current EEE Component Specialist, Project Lead, Space Systems Loral (SSL) - Palo Alto, CA

Responsibility Highlights:

1. Special project leader: commercial diode qualification for recurring cost avoidance.
2. Led Tiger Teams to address high impact issues involving tantalum capacitors and thin film resistor issues. RC & CA on issues that caused hardware failures up to the spacecraft level.
3. Revising author of PEI 1500-20 doc, EEE Parts Selection and Screening Requirements.
4. Manage subcontractors to ensure conformance with SSL's component's program
5. RAD New Components Technology Insertion team
6. Audit Domestic and International Suppliers and Subcontractors, >45 audits

Awards:

Multiple Achievement Awards from SSL & NASA award (Grail program)

Past Employment and/or Startup Activity

2013-2014 Project Lead, Terra Traveler (Startup), Mountain View, CA

2006 Engineering Intern, Fehr & Peer Transportation Consultants, Walnut Creek, CA

2005 Researcher, Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA

Professional Societies

2010-current IEEE Electron Devices Society Member, Silicon Valley Chapter

Patent

“Expandable solar array apparatus and method”

United States 13/998,239; Filed October 15, 2013

Discloses an invention for a high surface area solar array system based on flexible solar cell technology. In addition to providing for a much larger surface area of active solar cells, the invention also describes the optional use of expandable light concentrating elements, florescent conversion, and expandable reflectors to increase flux incident on the thin film photovoltaic structure. An optional thermal control/circulation system is also described. A fully optimized system is predicted to yield much greater energy production than present day rigid array or roll out (chinked armor) solar array systems.

C. Contribution to Science

None

D. Research Support

I have been doing fundamental research in logical, mathematical and scientific fields. This work is personal and unpublished. However my findings support a better understanding of reality and how the tools of mathematics can be applied to studying our discrete experiences that are quantifiable and physically manifest.

Ongoing work is being preformed in **Physics** - *RESTTIME* (Recursive Energy Stress Tensor Time Interaction Material Experience) *model development*, **Chemistry** - *electron pairing and new model of the electron as a compound particle made of small quarks*, and **Biology** - modeling behavior with computational mathematics and neuronal representations.

Areas of research: Dimensional Analysis, Map and Set Theory, Physics beyond the standard model that unites Quantum Mechanics with Relativity, Molecular Cell Biology and Neuroscience.

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE		
William M. Bowles	Co-Founder, Biomatica		
eRA COMMONS USER NAME: MIKE94301			
EDUCATION/TRAINING			
INSTITUTION AND LOCATION	DEGREE (if applicable)	MM/YY	FIELD OF STUDY
Oklahoma State University – Stillwater OK	BSME	12/1971	Mechanical Engineering
Oklahoma State University – Stillwater OK	MSME	6/1975	Mechanical Engineering
MIT – Cambridge MA	ScD	6/1980	Instrumentation
UCLA – Los Angeles	MBA	6/1991	Business

A. Personal Statement

A successful outcome of the work proposed here requires accomplishing the research aim. It also requires commercializing the product of the research and getting it into the market place. My chosen career path has equipped me to accomplish both of these ends. When I began work at Hughes Aircraft Co. in the Space and Communication division, I managed satellite development projects. This required basic management skills and basic research in some cases. After getting an MBA I moved out of developing satellites to work developing new business enterprises at Hughes. As an example, the group I was in developed the concept and business plan for DirecTV. The group also developed a number of less well-known but very profitable businesses.

The success of DirecTV was based on three things. 1.) a technology change from landline to satellite delivery 2.) a vast improvement in delivery economics - the cost of getting TV signal to a household dropped from \$1000/house to \$50/house and 3.) a marketing plan to capture enough market to turn a profit.

Subsequent to Hughes I've had the good fortune to have put together two tech startups that went public and made early investors very happy. With both of those I was the first employee, hired the engineering and management teams, put together the business plans, raised the financing, made the coffee, fixed the copier and did whatever else was required to get up and running. My experience at Hughes established a basic model for a new enterprise.

Wave Form Analytics follows a similar model. The company is developing new technology - using modern machine learning on a big data set to predict the mental state of users. If successful, the research we're proposing promises substantial knowledge and economic improvements for researchers, diagnosticians and businesses. These improvements can lead to new insights for mental and brain researchers, non-invasive

diagnosis of mental impairments and smoother interactions between humans and between machines and humans.

B. Positions and Honors

1979 – 1981	<u>C. Stark Draper Assistant Professor</u> MIT <i>Senior Scientist</i>
1981 – 1991	Hughes Aircraft, Space and Communications Group
1991 – 1993	Director New Business Initiation Hughes Aircraft, Space and Communications Group
1993 – 1996	Founding CEO Com21 (cable modem startup)
1997 – 1999	Founding CEO iBeam Broadcasting (hosted streaming traffic)
2001 – Present	Sole Proprietor Machine Learning Consulting
2010 – Present	Machine Learning Instructor HackerDojo (incubator in Silicon Valley)
2012 – 2014	Co-Founder Biomatica
2012 - Present	Startup Advisory Boards Advisory Role to Startup Companies
2015 - Present	Professor, Machine Learning Galvanize U
2015 - Present	Startup Mentor IndieBio (Biotech incubator SF)

Other Experience and Professional Memberships

Association of Computing Machinery
International Society for Computational Biology
VP Career Development MIT Club Northern California

Honors

First holder of C. Stark Draper Chair at MIT

C. Selected Peer-reviewed Publications

Bowles, W. M. and Shigeta, R. T. “Statistical Models for Predicting Liver Toxicity from Genomic Data” Systems Biomedicine 1:3, 1-6; July/August/September 2013, Landes Bioscience

Bowles, W. M. Machine Learning in Python: Essential Techniques, John Wiley & Sons, Indianapolis, 2015

D. Research Support

Previous research funded by venture capital.

BIOGRAPHICAL SKETCH

NAME: Melanie Minor

eRA COMMONS USER NAME (credential, e.g., agency login): waveformmm

POSITION TITLE: Senior Researcher and Subject Matter Expert

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
San Francisco City College	None	5/2009	GE/Physics
University College Dublin Ireland	B.Sc. (2.1 Honors)	5/2013	Neuroscience and Pharmacology

A. Personal Statement

My 2.1 honors degree in Neuroscience came from the top science university in Ireland. Europe does not include general education in their 4 year curriculum, so I got to spend that time studying subjects including physiology, pharmacology, and neuroscience. A large majority (>30) of those courses involved a substantial research portion with full experiments, including reporting that was completed bimonthly. I was afforded the opportunity to work on a year-long thesis in neuropsychology. My role in the Waveform Analytics, is filling the information gaps between current research on bipolar disorder, including voice analysis research, and the specific information we need to apply to our mobile application. Field testing of our hypothesis about voice characteristics related to mood trending will play a vital part of the validation of our approach. My last successful research endeavor examined the role holistic processing plays in dyslexia and why. The procedure for gathering voice analysis data would be very similar in most respects. Along with prior experience of this type of process, my keen eye for detail and love of problem solving will contribute to successful design of our processes and methods for clinical and field studies. Prioritization of what information is needed and how the research should progress, by finding errors in peers' and mentors' research throughout the years, has honed my critical thinking skills relevant to scientific work. I have over a decade of experience working with people, teaching, and analyzing human behavior. My ability to be self-motivated has proven to be a vital strength for making sure there is successful execution of a study. It also makes me a good candidate for being the main interface between the resulting study group and Waveform Analytics. The association I have with groups focused strongly on mental health such as National Alliance of Mental Illness (NAMI) and Depression Bipolar Support Alliance (DBSA) are invaluable to the problem we are targeting. I believe strongly that we will have their support.

I have a personal interest in Waveform Analytics goal, suffering from bipolar disorder myself. It started when I was hospitalized because I had been undiagnosed since the first signs were documented 13 years prior. I had already had several courses at my university that collectively provided me with solid knowledge on the subject, but it wasn't until that experience that it all came into perspective. My recovery included extensive research into the disorder and self-monitoring. This was not only because of my own curiosity, but also because of the lack of tools to follow up with or educate myself on my condition other than expensive

psychiatrists and therapists. I had to find my own way to monitor my mood and interpret that to better understand my illness during a very confusing time. The current collection of mental health apps is commonly referred to as “mood trackers” because they are just that. They are based on self-reporting, and display your results with no further interpretation. That was not enough to offer any additional insight into my disorder, and my search came up empty when I tried to find one that would. I’m divulging all of this because I want to highlight the impact an application like ours could have on the mental health field. Bipolar is a chronic affective disorder that can be very confusing and dangerous for those suffering from the chemical imbalances that provide for the clusters of symptoms that collectively are classified under Bipolar Disorder. The people that make up bipolar patients support systems can find dealing with the bipolar person draining and challenging even if they understand bipolar and know the individual well. I am very passionate about this project, and am grateful that my expertise will be used for something this impactful. This application will ease a lot of suffering when we’re done with it.

B. Positions and Honors

2015-current Senior Researcher and Subject Matter Expert, Waveform Analytics, Mountain View, CA

2012-2013 Researcher, Neuropsychology, UCD School of Biomolecular and Biomedical Sciences, Dublin, Ireland

C. Contribution to Science

N/A

D. Research Support

Holistic Processing in Dyslexia

-To investigate and compare the roll holistic processing has on reading in dyslexic and non-dyslexic subjects, and why.