QUANTITATIVE ENGINEERING DESIGN

*Bringing the **Hacker Spirit** to **Global Development***

Company Profile

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Introduction and Mission

QED builds data systems and AI for human health and agriculture, the two fields that we believe to be most relevant to the security of humankind. It is a fully mission-driven technology company, working on development and humanitarian projects with regional expertise based in Sub-Saharan Africa, South Asia, and Latin America that aligns with the **UN Sustainable Development Goals** 2, 3, 6, and 15.

We aim to empower local organizations that have outstanding development and humanitarian goals with strong local presence. By leveraging our technologies and knowledge, we shape and adapt software and hardware to address needs on the ground, to better collect and analyze data to inform policy decisions.

Our technologists collaborate with organizations by embedding with them on the ground for extended periods of time, working with local experts. Together, we develop practical solutions informed by realistic requirements and infrastructural limitations. Training is also an important part of our work, to develop local capacity and ensure project sustainability.

Since its inception in 2012, QED has provided mission-critical support to many health and agricultural projects, across 13 countries. We have built data processing pipelines for the surveillance of malaria, child mortality, crop disease, and soil health, and we provide the analytical tools required for our partners to execute targeted interventions. Our projects are executed in collaboration with organizations such as the Centers for Disease Control and Prevention (CDC), the Gates Foundation (BMGF), the International Maize and Wheat Improvement Center (CIMMYT), and the United States Agency for International Development (USAID).

Current & Past Clientele

Agriculture

Bill & Melinda Gates foundation · USAID From the American People · AFAP · CIMMYT International Maize and Wheat Improvement Center · The Nature Conservancy · AFSIS · Agrifund · CIESIN Columbia University · OMNIA

Health

CDC Centers for Disease Control and Prevention · LSTM Liverpool School of Tropical Medicine · Kenya Medical Research Institute KEMRI · ICAP Columbia University Mailman School of Public Health · Washington State University · Oregon Health & Science University OHSU

Global Health

qed:health

The battle against HIV, malaria, tuberculosis, and children under-5 mortality relies crucially on health information systems (HIS) for timely monitoring and surveillance. While many digital health systems are being deployed in the developing world, their scalability is often limited due to local constraints in infrastructure and human resources. Consequently, digital systems can amplify data entry burden, leaving little bandwidth for data analysis. QED develops novel systems that are built for, built with, and adaptable to resource-poor environments, including the automation of visualization of data insights.

ScanForm: Phone Scannable Paper

Product: Phone-scannable form technology that increases the efficiency of using paper forms by rapidly digitizing handwritten contents into Excel, in 60 seconds. All that is required is paper and a mid-range Android smartphone camera. Custom analytics produced in real time.

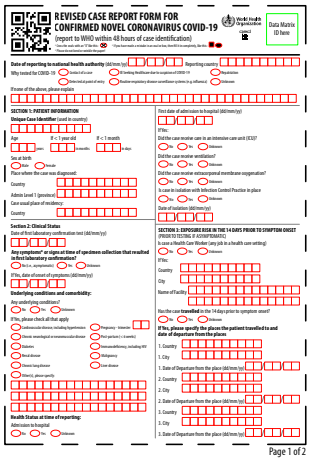
Website: https://qed.ai/scanform
Video: https://scanform-animation.qed.ai

Selected Applications:

- **Scalable Medical Surveillance:** Nationally-scalable geospatial surveillance of malaria, HIV, TB, and other diseases in Africa is made possible by applying ScanForm to medical forms commonly found in rural health clinics. Examples include the Antenatal Care register, Outpatient Department register, HIV surveillance records, HIV case-based surveillance, and more.

- **Clinical Trials and Immunization Delivery:** Digital data systems to support medical interventions can be provided in low-infrastructure rural conditions while still retaining the natural pen-to-paper interface. ScanForm is being used to support influenza vaccinations and malaria prophylactics.

- **Human Rights:** Refugees and trafficking victims needing legal assistance are supported by paper forms, easily distributed and carried, and all readily digitizable with ScanForm.


REVISED CASE REPORT FORM FOR CONFIRMED NOVEL CORONAVIRUS COVID-19
(report to WHO within 48 hours of case identification)
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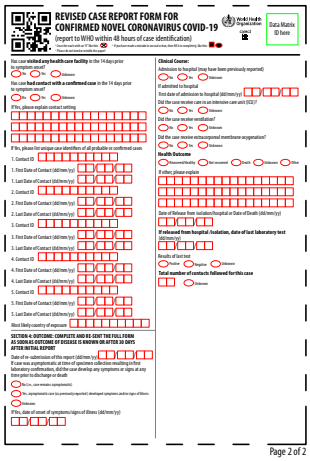
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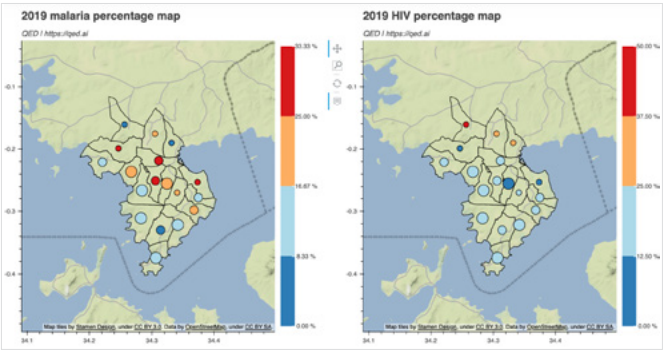
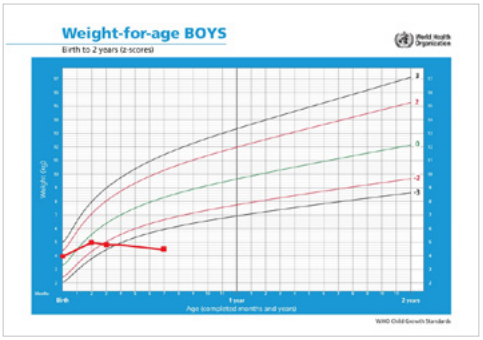


Digital Medical Record Systems

Project: Child Health and Mortality Prevention and Surveillance (CHAMPS)

Description: CHAMPS is a 20-year BMGF-funded project to determine the causes of high mortality rates for children under-5 at targeted sites around the world. QED built the data systems to run CHAMPS in Kisumu, Kenya, including end-to-end electronic data capture, data exports, and automated dashboards for tracking performance indicators. The system is used and built in collaboration with clinicians and pathologists at KEMRI[1] and JOORTH[2].

Outcomes: CHAMPS has helped both families and doctors understand why children die, bringing closure to families and illuminating child mortality research. The project has demonstrated the importance of postmortem tissue sampling and causal chains of death. The data has also exposed unusual prevalence of certain chronic conditions, which are now being acted upon in local health systems.



More information: https://qed.ai/champs

Project: Mobile Hospitals

Description: In pursuit of the 90-90-90 targets for eliminating HIV/AIDS by the year 2030, QED has been working with ICAP at Columbia University[3] on mobile hospitals, to bring HIV care to rural communities that otherwise lack easy access. Working with local experts, QED develops systems to optimize the routing of these trucks across rugged terrains, and to schedule their movement to maximize patients served. In addition, all medical workflows in the truck, including triage, screening, clinical work, and counseling, are supported by both tablet and desktop-based software from QED, designed with strong consideration for intermittent internet conditions and cybersecurity needs.

[1] Kenya Medical Research Institute (KEMRI)
[2] Jaramogi Odinga Oginga Referral and Teaching Hospital (JOORTH)
[3] ICAP at Columbia University Mailman School of Public Health

Agriculture and Food Security

qed.ai/ag

Digital Pipelines for Agricultural Research

Project: Africa Soil Information Service (AfSIS)

Description: Africa has great need for improved soil fertility management, and the most unmet potential in farming productivity. However, most governments have limited information about present-day soil conditions, relying on legacy surveys from over 50 years ago. The AfSIS project (2009-2019) was developed by BMGF to start filling this information gap. By devising more efficient ways of mapping soil health at national scales, governments and fertilizer companies can be better informed to tailor inputs for each nation's soil and crop nutritional needs.

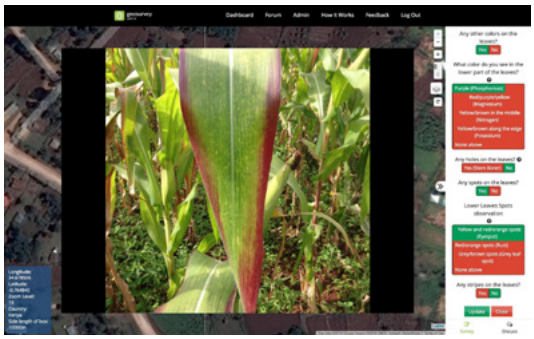
Tech: In 2014, working in collaboration with international partners, QED was onboarded to build an **end-to-end digital infrastructure** for AfSIS, including digital field sampling, infrared spectroscopy, lab information management systems, artificial intelligence for soil chemistry and cropland inference, and web-based geospatial maps. These tools were used in Tanzania, Ethiopia, Ghana, and Nigeria, where new labs were erected, and new large-scale soil surveys were conducted.

Outcomes: AfSIS created and inspired several national soil information services both within and beyond Africa. Examples include the Ethiopian Soil Information Service (EthioSIS), which conducted sweeping national soil surveys and adopted many methods and computational training from QED, and the Soil Intelligence System for India. More broadly, AfSIS produced the largest public dataset of African soil chemistry data, greater than 10-times larger than all soil data gathered since the 1960s. QED brokered a rare partnership with Amazon to host this data at the Registry of Open Data, in perpetuity. QED's work was spotlighted during a keynote tech talk at Goalkeepers 2018.

Video: http://y2u.be/Fb9R0CnPMkc

Visual Telemedicine and Crop Health Surveillance

Motivation: Plant diseases, nutrient deficiencies, and pests present large threats to global food security, resulting in hundreds of billions of dollars in lost crop production annually. A particularly vulnerable population is the 2.5 billion smallholder farmers worldwide working on plots of sizes less than two hectares and providing 80 percent of the food supply in developing countries. Due to the very wide spectrum of possible crop health illnesses, many farmers lack the agronomic training to translate visual symptoms into correct diagnoses and treatments. In tandem, there are few plant health experts across Africa, and these valuable experts are not able to address the needs across the continent.



Tech: QED provides an Android app to agricultural experts and extension workers to capture pictures of crop health illnesses and in-field questionnaires. This symptomatic data is then fed to plant pathologists that provide expert remote diagnosis and remediation through a web interface (Geosurvey). The system facilitates having multiple diagnoses, discussion threads, performance statistics, and privacy sharing options.

Outcomes: The system has been used by farming cooperatives to capture photos of maize health issues in participating farms across Kenya, providing near real-time interactive maps of fall armyworm outbreaks, maize streak virus, and nutrient deficiencies.

Website: https://qed.ai/geosurvey-collect

In-Field Chemistry and Spectroscopy

Motivation: Formal soil testing and plant health diagnosis requires laboratory chemistry techniques. However, in the developing world there is limited access to chemistry labs for agricultural analysis, partly due to the high costs of traditional desktop instruments. Ferrying samples and results between the field and the lab results in high logistical expenses. Turnaround times can be so slow that windows of opportunity for agricultural intervention are missed.

Portable Automated Colorimetry Kit (PACK)

Tech: To address the gap in acquiring timely agronomic information, QED has been building miniaturized mechatronic boxes for performing soil compositional analyses in the field. These devices rely on the same colorimetric procedures used by soil scientists, but are fully-automated to minimize human error and inconsistency. Our results are also backed by side-by-side comparisons against manual operators from accredited wet chemistry labs. The boxes are portable, and fit easily into a backpack or on the back of a motorbike. The only energy source required is a standard USB power bank, and the box can be programmed to measure different nutrients. An analysis of soil carbon or extractable phosphorus, which may normally take several weeks or months to return, can be done in 20-30 minutes. Our tech empowers extension workers to provide rapid insights and inform constituents about their fertilizer needs, on-site.

ScanSpectrum

Motivation: Infrared (IR) spectroscopy, when coupled with machine learning on wet chemistry datasets, has proven capable of inferring important soil and plant properties with reasonable accuracy. Examples include pH, Nitrogen and Organic Carbon for soil testing. The result is an attractive “dry chemistry” system with less maintenance and moving parts. However, existing IR equipment to realize this system is expensive and not portable.

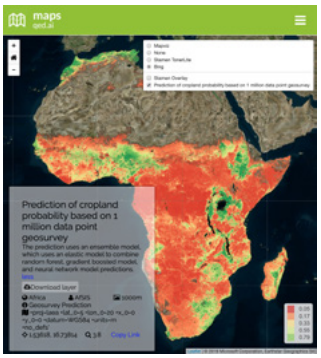
Tech: QED has built a gun-shaped portable spectrophotometer covering the visible and infrared bands, called ScanSpectrum. The device interfaces with an Android phone, shines light onto a specimen in either transmittance or reflectance modes, and returns both a spectrogram and NDVI readings in a matter of seconds. The data is georeferenced and backed up in the cloud in openly accessible formats, enabling machine learning later. The device is carried in a fitted, compact case, complete with documentation, accessories, and spare parts. Wavelength ranges and sample loading modules can be customized to meet client-specific needs.

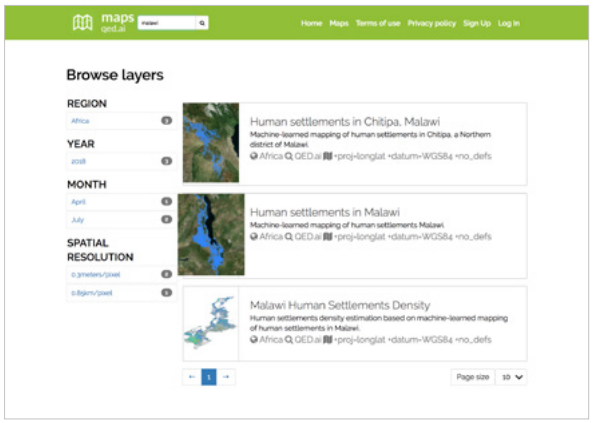
Website: https://qed.ai/scanspectrum

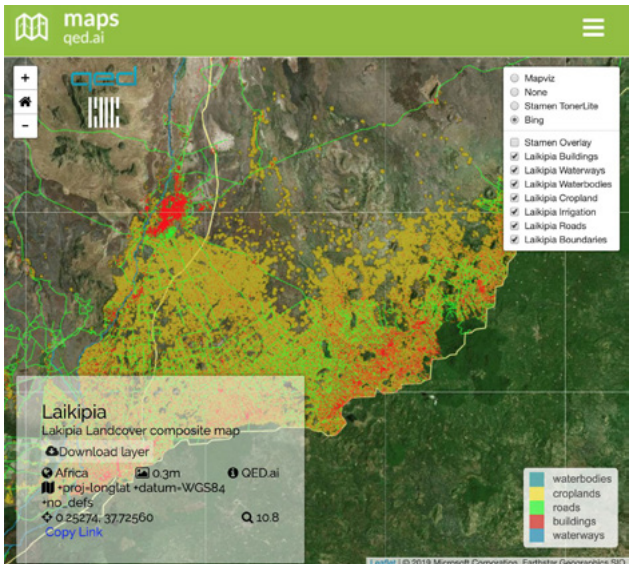
Environment and GIS

National Mapping of Land Cover Use and Building Footprints

Product: QED has been generating many national-scale maps of building footprints, croplands, and forests in Sub-Saharan Africa and South Asia over the past six years. QED uses a combination of deep learning and geospatial annotation, honed through many years of R&D, in which small percentages of countries are manually classified through a web-based platform, and the vast remainder of the region of interest is then extrapolated using artificial intelligence and transfer learning. The resulting maps are scalably hosted at our online Maps platform, for interactive inspection and visualization.

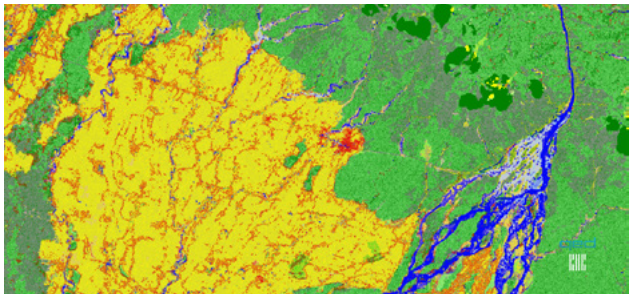






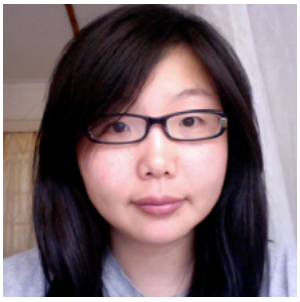
Selected Applications:

- Mapping of building footprints for energy companies to plan rural grid electrification
- Mapping of building footprints to optimize logistical delivery of drugs and immunizations
- Calculation of arable lands in Africa, to better inform fertilizer and food processing sector about market needs and geospatial expansion strategy
- Mapping croplands to plan soil sampling expeditions for national-scale surveys in Africa
- Mapping of all buildings, croplands, roads, and agro-dealers in Nepal, providing geospatial intelligence for more efficient distribution of seed, fertilizer, and agricultural interventions (https://maps-nsaf.qed.ai)



Team

QED was co-founded by a spatial-temporal statistician (Dr. Jiehua Chen) and an ex-NASA engineer (Dr. William Wu), who have been working on international development for over a decade, and have worked and lived in East Africa. The company was founded to mobilize highly talented engineers toward fundamental problems in global health and food security, particularly throughout the developing world.



Dr. Jiehua Chen

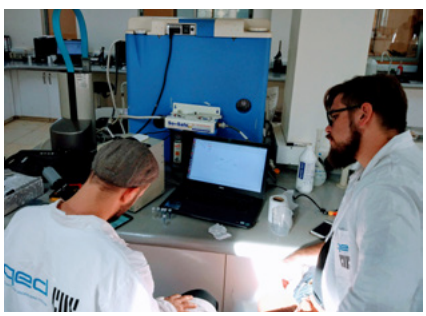
Dr. William Wu

Today, the team consists of roughly twenty back-end and front-end software engineers, data scientists, and mechatronics experts. QED places a high premium on algorithmic intelligence combined with practical know-how. Many of its staff have previously worked at large tech companies and trained in international programming competitions. The team is also supported by a few in-house experts in health and agriculture, while relying on collaborations with partners for deeper domain expertise.



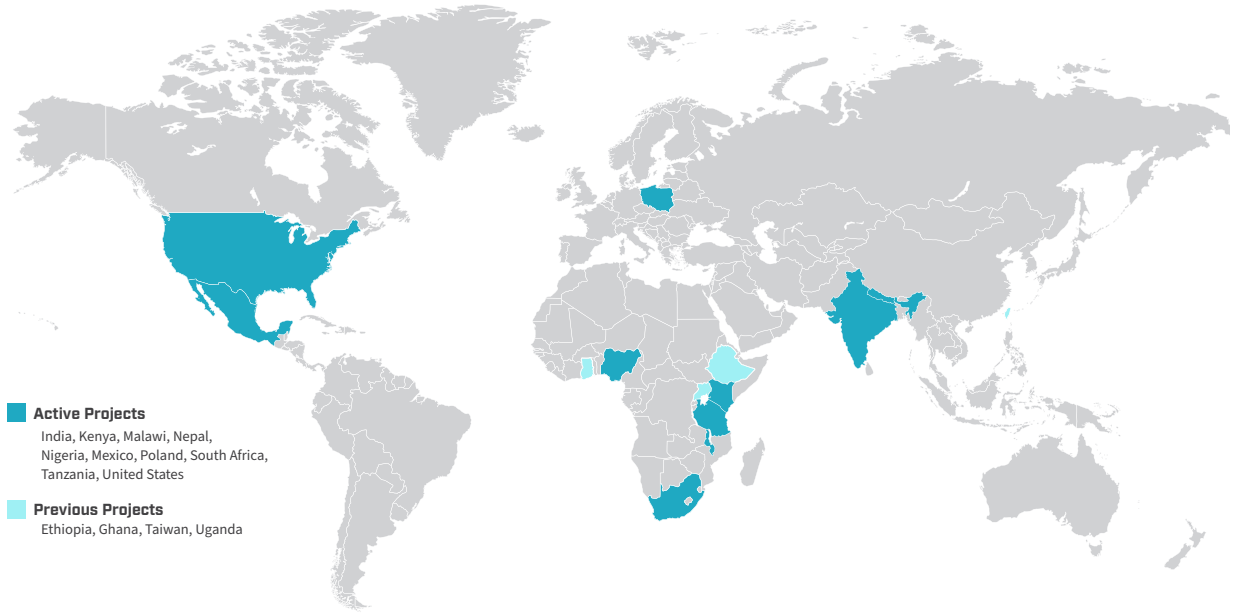






Geographic Areas

The map below shows regions where QED has worked on challenges in sustainable development. QED is registered in the USA, the European Union (Poland), and Sub-Saharan Africa (Kenya).



Publicity and Recognition

QED regularly presents its work at nearly 40 different venues per year, including conferences, stakeholder meetings, workshops, universities, and industry round table events.

QED is being featured in a growing number of international news outlets, some of which are shown below. **In 2019, QED's work was recognized on Bill Gates's blog, The Gates Notes.**

Gates Notes: Here's one great way to use your tech skills

MSNBC: Bill Gates - This is a 'great' way to use your tech skills

Gates Foundation, Beijing China: 土壤:你脚下的大数据 (Soil: Big Data Beneath Your Feet)

DevEx: Meet a technologist building digital data systems for dirt

CIAT Insights: Without open data, there's no big data for smallholder agriculture

For more information and videos, please visit https://qed.ai/press.

Business Inquiries: https://qed.ai/contact
E-mail: info@qed.ai
Media Kit: https://qed.ai/media-kit

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