

Gaetano Borriello, 1958–2015

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The IEEE Pervasive Computing community wishes to remember and celebrate the achievements of Gaetano Borriello, one of the founding members of our editorial board, who died on 1 February 2015. Borriello was a giant in the field of ubiquitous computing, and his most recent work on the Open Data Kit (ODK) supported humanitarian aid, conservation, and outreach to the developing regions of the world.

At the time of his death, he was the Jerre D. Noe Professor of Computer Science & Engineering at the University of Washington, where he had been on the faculty for more than 25 years. Prior to joining UW, he had been a member of the research staff at the Xerox Palo Alto Research Center from 1980 to 1987, where he contributed to the design of the first single-chip integrated Ethernet controller. He earned his PhD in computer science from the University of California, Berkeley in 1988 and his MS in electrical engineering from Stanford University in 1981.

During 2001–2003, Borriello took leave from UW and founded Intel Research Seattle, which focused on the area of ubiquitous computing. Under his guidance, Intel Research Seattle initiated research in elder care, using sensors and wearable devices to help elders live at home longer—which, to this day, remains a strong focus of research around the world. He also made seminal contributions to



location-aware computing in his work on the PlaceLab project.

In 2004, Borriello co-authored a logic design textbook with Randy Katz, who was his PhD advisor at Berkeley. The book, *Contemporary Logic Design* (Prentice Hall), is used in many university courses. It was the first book to address the revolutionary changes in hardware design that streamline the design process through the use of CAD software, rapid prototyping, and programmable logic devices.

During the 2008–2009 timeframe, Borriello took a sabbatical at Google Seattle, where he moved into the space of applying mobile computing technology to help people in developing regions of the world. This inspired great passion in Borriello and remained his focus until his passing.

Over the course of his career, Borriello received numerous awards and recognitions. He is recognized as an IEEE Fellow, an ACM Fellow, and a Fulbright Scholar. The University of Washington recognized him with the UW Distinguished Teaching Award for his contributions in establishing its Computer Engineering degree program, and also awarded him with the Marsha L. Landolt Distinguished Graduate Mentor Award.

LOCATION-AWARE COMPUTING

During Borriello's years at Intel Research Seattle, he and his colleagues worked on many initiatives in the field of ubiquitous computing, including location awareness. One of the papers he co-authored with Jeffrey Hightower was "Location Systems for Ubiquitous Computing." This survey, published in the August 2001 issue of *Computer*, offered readers a taxonomy of location systems, describing a variety of approaches and classifying them according to various characteristics. The paper was highly influential in the community and, according to Google Scholar, has been cited more than 3,500 times.

IMPACT OF THE OPEN DATA KIT

In recent years, Borriello's work focused on applying technology to address real-world problems in developing regions. This is a mission he

was passionate about, influencing the problems he chose and evident in the value of the solutions he created. Here I include a sampling of the types of problems he and his students tackled, and also how he touched each of the following organizations on a personal level as well.

The Jane Goodall Institute

In remembering Borriello, Jane Goodall wrote about the reach of ODK, which has helped “empower and give voice to hundreds of village forest monitors and protected area rangers in Tanzania, Uganda, Congo and Eastern DRC so they can help conserve their forests and ecosystems for the benefit of present and future generations” (<http://lazowska.cs.washington.edu/Goodall.pdf>). She went on to add that “Borriello and his students were instrumental in helping the Institute improve our process of collecting data in our long-term chimpanzee behavior research in Gombe, Tanzania, where I started my work in 1960.”

However, she didn’t just talk about Borriello’s work. In expressing her condolences to Borriello’s family and colleagues, she also recalled “his kindness, thoughtfulness, and desire to be of service, as well as his humble nature and the unassuming way in which he was developing the next generation of computer scientists and engineers so they too can use their knowledge to improve the lives of others. What a great loss indeed he is to our world.”

The Red Cross

The International Federation of the Red Cross and Red Crescent Societies recently rolled out an ODK-based data-collection tool, which they trialed during a workshop in which participants collected data from the local community.¹

In hearing the news of Borriello’s passing, Xavier Castellanos and Lorenzo Violante shared the legacy of his work on their organization:

GAETANO BORRIELLO ENDOWED FELLOWSHIP FOR CHANGE

The University of Washington has created the Gaetano Borriello Endowed Fellowship for Change to honor him. This Fellowship will support students whose work is focused on exploring how technology can improve the lives of under-served populations. If you’d like to make a donation in his memory, see <https://www.washington.edu/giving/make-a-gift/?page=make&code=GBEDFL>.

“Since the Haiti Earthquake in 2010, the International Federation of the Red Cross has exponentially used ODK for our relief and recovery programmes, changing the way we work in support of communities affected by disasters around the globe” (<http://lazowska.cs.washington.edu/RedCross.pdf>).

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PATH

PATH, a Seattle-based nonprofit (www.path.org) focused on global health innovation, recognized numerous projects that Borriello and his students have contributed to over the years, including

- *Human Milk Banking*, which provides human milk pasteurization by leveraging a smartphone (www.path.org/publications/files/MCHN_foneastra_pos.pdf);
- *the Mobile Midwife project*, which built a low-cost, portable ultrasound device that could be used by midwives to detect placenta previa, multiple gestations, and breech presentation (<http://change.washington.edu/projects/mobile-midwives-ultrasound>); and
- *the mPneumonia project*, which provides a smartphone-based application that provides pulse oximetry and measures respiration rates to

help fight childhood pneumonia (www.path.org/publications/files/TS_update_mpneumo_app.pdf).

In addition, Richard Anderson, who worked with Borriello at PATH as well as UW, remembered Borriello as a visionary who could “anticipate trends so that he could be an early developer of technologies that would later be appropriate to deploy in low-resource settings.” As Anderson explained, Borriello “began his work on ODK when smartphones were exclusively a product for the affluent, arguing that they would soon be ubiquitous, creating opportunities to provide services to a vast number of people in developing countries.”²

TEDX TALK 2010

In 2010, Borriello gave a TEDx Seattle talk about his work in Tanzania. This project was addressing the problem of too few medical doctors for the population—in Tanzania, there’s one doctor for every 50,000 people (in the US, there’s one doctor for every 430 people).

Borriello’s team took a paper manual that was used by clinicians with minimal medical training to diagnose childhood illnesses and translated that manual into an app on a mobile phone. Their goal was to help fill the medical gap resulting from having too few doctors by using technology to capture data, help interpret that data, and then provide the appropriate advice. The results were impressive: this simple intervention resulted in a 25 percent increase in the number

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of cases adhering to the protocol (from 60 percent adherence to 85 percent adherence), and with a minimal increase in the amount of time required of the clinicians. Borriello's talk demonstrates how simple interventions can have profound human impact (see <https://www.youtube.com/watch?v=-X7evoDIDQU>).

UBICOMP 2014 CLOSING KEYNOTE


Borriello gave the closing keynote at the 2014 Ubicomp conference. If you were not able to attend, I strongly encourage you to listen to the recording (<https://vimeo.com/108272339>). In his talk, he tells stories from throughout his career, focused on his work in ubiquitous computing and continuing on to his recent work in developing

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regions of the world. I found the video of student projects from the 1998 time-frame inspiring in the foreshadowing of apps yet to go viral. I was inspired by the stories about the many projects done with NGOs in developing regions and the profound changes those projects had on the people. He ends with lessons from his journey, which I will recap here.

First, he recommends working on real problems. The funding will follow once you engage and put your heart and soul into the effort. Second, he recommends collaborating with experts in the application domain. Though this does incur some overhead, it's well worth it. Third, he recommends

disseminating your work openly. If your work is solving a real problem, others will build on your work and help you develop it. Fourth, he recommends developing new capabilities. You need to generate new capabilities all the time based on your experiences. Finally, he recommends following your students. The best work comes from people who are highly motivated and happy. Great advice for all of us!

Gaetano Borriello was a mentor to many of us, spending much of his time helping others in our community. In doing so, he touched many lives, from his students and colleagues at UW to mothers and children in Tanzania. His legacy will live on through the efforts he began and through the impact and influence he has had in this community and around the world. He will be missed by all who had the privilege to work with him. Our heartfelt condolences go out to his friends and family. 

REFERENCES

1. K. Marshall, "21st Century Data Collection Takes Health Promotion to Vulnerable Communities in the Philippines," International Federation of the Red Cross and Red Crescent Societies, 3 July 2014; www.ifrc.org/en/news-and-media/news-stories/asia-pacific/philippines/21st-century-data-collection-takes-health-promotion-to-vulnerable-communities-in-the-philippines-66278.
2. "PATH recognizes the contributions of Dr. Gaetano Borriello," PATH, 6 Feb. 2015; www.path.org/blog/2015/02/remembering-gaetano.

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