Works in Progress

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ICTD Work, Plus mFeel

EDITOR'S INTRO

In this issue's Works-In-Progress department, we have four entries related to the issue's theme, Information and Communication Technologies for Development (ICTD), and a fifth entry on the mFeel mobile system, which combines context awareness with affective and cognitive techniques. — *Anthony Joseph*

SUSTAINABLE ICT IN AGRICULTURAL VALUE CHAINS

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Information and Communication Technologies for Development (ICTD) solutions could provide long-term benefits for agricultural value chains. However, in many technical ICTD projects, only prototypical implementations, built for a specific, small-scale use-case scenario, have been tested. This limits their viability and thus doesn't foster socioeconomic development. For long-term sustainability, technical ICTD solutions must focus on reusability and scalability. We thus propose a generic-architecture concept that supports the development of reusable, extensible, and scalable ICT solutions.

During more than five years of in-situ research in South Africa, Ghana, and Burkina Faso, we've developed what we believe is the first technical ICTD architecture with successful sustainable instantiations in three different projects. It's called the *Sustainable Bottom Billion Architecture*. Starting in 2007 with the instantiation in the Collaboration@Rural project, we replicated the concepts in the African Cashew initiative in 2010 and in the Start Shea Network in 2011. The SBBA combines and extends existing project-specific solutions to create a well-tested, reusable, and scalable architecture that enables the development of sustainable solutions, tailor-made for the agricultural sector.

Alongside the SBBA, we produced a software development methodology, called the Technical ICTD Methodology (TIM), which supports the creation of sustainable, scalable, and replicable ICT solutions. It combines and adapts established interaction design methods to offer a three-phase development life cycle that supports prototyping, deployment, and productive use and scaling in a Living Lab setup. (This setup has end users participate as co-creators during experiments in real-world settings.)

Building on the sustainable output generated in cashew and shea value chains, our current activities focus on scaling up the solution, creating a horizontal replication in other agricultural value chains (such as coffee or cotton), and vertically extending the solution to include additional features, such as a mobile payment option.

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MEASURING SOCIAL INCLUSION IN PRIMARY SCHOOLS

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The United Nations recently declared that equal access to education is a basic human right.[1] This has reignited interest in *inclusive education*, an approach that seeks "education for all" by helping schools successfully respond to the diverse needs of all learners.

However, despite the increased attention for this educational approach, researchers lack empirical evidence on how exclusion is manifested in student behavior. They also need evidence of the long-term effects of existing methodologies that promote inclusion in schools.

In our line of research, we have three long-term goals:

- Develop a set of metrics of the inclusiveness of school communities, inferred from sensor data such as pair-wise proximity of children in the playground or the children's verbal participation in educational activities.
- Evaluate the impact of educational interventions, such as the "index for inclusion" methodology through longitudinal field deployment of sensor technology.
- Develop persuasive games that challenge children's perceptions of diversity, grounded in day-to-day data of

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their social interactions and drawing upon established principles of human motivation.

For more information about our work, contact Evangelos Karapanos at e.karapanos@gmail.com.

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AN ARCHITECTURE FOR GREEN MOBILE COMPUTATION

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In 2016, there will be more than 1 billion smartphone users, which amounts to a 30 percent increase in less than four years.[1] This leads us to ask, are mobile users aware of their devices' energy expenditures? Is all this energy really necessary to make the devices useful?

Today, more than 18 percent of energy consumed is used to process raw data retrieved from sensors. With recent improvements in embedded sensors, context-aware applications are booming, and use of such applications will only increase in the coming years.

We propose an integrated architecture for context-aware applications that lets context providers process all needed information. Then, using the architecture's access points, the providers could reuse the information for different applications, thus greatly reducing the applications' energy consumption.

Furthermore, this architecture will simplify the process of developing new context applications, because developers won't need to interact with sensors or process contextual information. The architecture will provide the correct context when necessary, thereby reducing development time by 20 to 40 percent and lowering development costs by, on average, US$1,900.[2]

Also, the use of this architecture could reduce the energy consumed by smartphones by 10 to 12 percent, thus decreasing the amount of CO_2 released into the atmosphere each year by 28,500,000 tons.[3]

For more information about our green architecture for mobile computation, contact Luis Miguel Soria-Morillo at lsoria@us.es.

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IMPROVING COMMUNICATION IN RESOURCE-POOR SETTINGS

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We're currently involved in a project that aims to increase security in sensitive (medical or administrative) transactions in unfriendly environments. Such environments are typical in areas with major telecommunication infrastructure deficiencies. In particular, we hope to reduce intermittent communications, which cause breaks in the flow of communication, and identify organizational aspects that influence the design and use of deployed services. We're also researching usability issues that hinder user acceptance, as well as the loss of information in failed transactions, which reduces users' confidence in the services deployed.

We've defined a model of communications in which all entities involved in communication exchange and share the same piece of information. These pieces of information, called Contract Documents (CDs), whose scheme is based on previously defined transaction to be performed, are filled and exchanged for all parties in the transaction. This way, all parties share almost the same information in every stage of the transaction. All entities can check the transaction's status and recover in case of failure, because they all have the same information. Furthermore, because the transaction's logic is defined in the schema of the CD and not in the communications protocol, the design of the transaction logic can be done by multidisciplinary teams to reflect the organizational status of the area in which the transaction is applied or the usability requirements.

Currently, we're working to verify the validity of our proposed communication model using an anthropometric monitoring system for children in rural areas with scarce resources.

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MFEEL: AN AFFECTIVE MOBILE SYSTEM

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Affective computing relates to how computers recognize and respond to human emotion. Although this field remains fairly undeveloped, sensor technology is improving rapidly in terms of accuracy, usability, and cost. It's now possible to connect biological sensors to computers, and mobile sensing is increasingly becoming a part of everyday life with the mobile phone's rapid evolution into a powerful sensing platform.

At King Saud University, we're investigating how mobile phones can recognize, interpret, and express human emotion. We're also looking into how we can better understand a person's emotional experience in a particular environment or

in response to a particular service. Emotions are personal, but they can be shared among groups, just as a person walking down a street might always experience the same emotion near a certain place.

The mFeel mobile system combines context awareness with affective and cognitive techniques to sense and react based on the user's biological state and surroundings. mFeel will enable various human-emotion scenarios through a primary "collective emotion" service (where the focus is more on the place than individual) and an "individual emotion" service.

We'll provide users with biological sensors—such as galvanic skin conductors (GSRs), electroencephalograms (EEGs), and temperature and heart-rate monitors—to collect hundreds of emotional traces around a city. We'll then correlate the collected emotional data with environmental data coming from pollution sensors, noise meters, and weather and traffic reports. Accumulating these digital footprints will provide a new opportunity to study human behaviors—that is, by collecting emotion data, along with data about pollution, noise, and weather, we'll be able to understand why a user is experiencing a particular emotion. The user can also annotate the data on the go with photos and tags for real-time online analysis.

We envision applying the mFeel system to personal-well-being and emotion-psychology applications as well as using it to improve urban and municipality design and management. Currently, we're carrying out some empirical user studies with an initial prototype that lets users tag their feelings and mood as they move around a city (see Figure 1). Once we complete these tests, we'll work on another set of experiments to collect sensor data from the fully developed prototype (currently at the proof-of-concept stage).

A mobile affective system will help capture stressful and serene moments, as well as moments of concentration and focus. It will also provide better insight into negative and positive events and will give users the ability to record their sentiment immediately or at a later time. The focus will be mainly on user reactions to the environment.

Figure 1. An initial mFeel prototype. Users tag their feelings and mood as they move around the city.

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Affective Computing is the field of study concerned with understanding, recognizing and utilizing human emotions in the design of computational systems. The *IEEE Transactions on Affective Computing* (*TAC*) is intended to be a cross disciplinary and international archive journal aimed at disseminating results of research on the design of systems that can recognize, interpret, and simulate human emotions and related affective phenomena.

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