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WORKSHOP ON OPEN SOURCE SOLUTIONS FOR THE INTERNET OF THINGS

Abstracts

An energy efficient communications for P2P mobile network over MANET

Balu Deokate, India

- Nowadays people are using mobile phones for communications. These communications are based on cellular and Wi-Fi networks. But still there is no cellular network connectivity in most of the remote locations of India and Africa. In these kind of scenarios, we can create a mobile ad-hoc network for communications. Mobile devices are weak devices from basic resources point of view. So to provide energy efficient communications in remote area, we are going to optimize the communication stack by reducing communication overhead of network and application layer routing. An optimized communication stack will be used to provide a services like messaging and voice calling in the remote locations.

Information Access for Development - Designing Innovative ICT4D Systems for the Developing World. Case Study - Mr. Meteo

Francis Dittoh, Ghana

- The onset of global warming and climate change in recent years has brought about changes in weather patterns in rural Africa just as everywhere else. Rural farmers, who previously utilized traditional methods of determining climatic conditions and the appropriate time to carry out corresponding farming practices now find it difficult to rely on these methods. Mr. Meteo is aimed at reducing the lack of knowledge of climatic conditions within farmers in rural areas. The system will, using available sources, provide weather information and weather forecasts in local languages to rural areas by way of voice technologies. Using a combination of technologies including PlugPC (Raspberry Pi) and Interactive Voice Response (IVR) over GSM (Coded with VXML) coupled with Short Message Service (SMS) and Radio Data System (RDS) for data transfer, the use case provides a cost-efficient and sustainable system for providing rural communities with access to relevant and specific information that can be deployed and maintained by Non-Governmental Organizations, Institutions and Companies involved in rural development.

Investigation of the Roles of the Key Players in the Future of IRAN Internet of Things (IoT) Market and IRAN's successful experience Report

EBRAHIMI Farzad, Iran

- In this research, the roles of the key players have been investigated in the Iran Internet of Things (IoT) Industry, consisting of both Governmental and private sectors, including Center for Innovation and Technology Cooperation of Iran Presidency, Supreme Council of Cyberspace, Ministry of Communications and Information Technology, ICT Research Institute, Iran ICT Guild Organization and IoT Academy of Iran in order to Shape and Lead the Future of Iran IoT Market. Afterwards, Iran's successful experience in Cultural Diffusion of IoT Knowledge over the country and training of specialized human resources in the field of Internet of Things as an essential prerequisite for shaping IoT Market will be discussed.

Causal methodology for the formal specification of problems and the structural specification of its solution

FLORES CORTEZ Omar, El Salvador

- My doctoral thesis is part of a research line that seeks to formalize a formal causal methodology to solve problems and to develop an automated environment of aid in the decision making of engineering design for the solution of problems. It is intended to provide scientific knowledge that increases the objective justification of solutions to problems in exchange decreases the arbitrary part that comes from the inspiration of the engineer and, thereby, increases the rigor of the procedure and reliability of the result. Specifically, my work seeks to contribute knowledge about the formalization of a causal methodology, to provide a conceptual framework for systematically performing design operations and to help make decisions to solve problems and create inventions. In addition, this thesis aims to develop a first outline of computer simulator that implements a first automated approach of causal methodology that helps in the decision making of engineering design.

Predicting frost events for farmers: an IoT + data science solution

DIEDRICHS Ana Laura, Argentina

- A big part of production in Mendoza region (Argentina) was lost because of frost. In a couple of hours, farmers can lose everything. Handling a frost event is possible, but it is hard to predict when it is going to happen. The goal of the project is to predict frost events by analyzing measurements from sensors deployed around an orchard. We present an in-depth description of a complete solution we designed and deployed: the low-power wireless network and the back-end system. The low-power wireless network is composed entirely of commercial off-the-shelf devices. We develop a methodology for deploying the network and present the open-source tools to assist with the deployment and to monitor the network. The deployed low-power wireless mesh network is 100% reliable, with end-to-end latency below 2 s, and over 3 years of battery lifetime. We are planning to use data science tools such as machine learning to build the prediction system.

A Model for the Design and Development of mAgriculture Applications

AMOS GICHAMBA, Kenya

- The presence of mobile phone-based solutions in Kenya that would be a solution to a number of problems faced within the dairy sector in developing countries has not had a major impact in dealing with existing challenges. There is therefore a need to develop a model to guide the design and implementation of mAgriculture applications in dairy farming, so as to provide clear guideline to developers, researchers and other stakeholders in mAgriculture. This research aims to investigate the challenges facing the usage of mAgriculture applications, to establish the factors that lead to successful or unsuccessful design and implementation of mAgriculture applications, to model the identified factors and challenges into a perspective that will guide the design and implementation of mAgriculture applications and to validate the model using a user-centric mAgriculture prototype for dairy farmers which is informed by model.

Internet-of-Things for Cyber Healthcare (IoT4C): Information Dissemination, Systems' Interoperability and Security

Claude Kakoko Lubamba, DRC

- The IoT4C project was one that I worked on in 2015-2016 and I worked on this project because, Cyber Healthcare is becoming one of the fastest growing industries in the world due to an increasing elderly population and a more health conscious word population. On the other hand, IoT devices are emerging from niche areas to provide new services that we could not fathom without the technological advances made in IoT and healthcare fields. Wireless Sensor Networking (WSN) is a promising approach to cyber healthcare as it can enable real-time monitoring of patients and early detection of emergency conditions and diseases. However, there are a number of issues that need to be addressed in order to benefit from the cyber healthcare promises. The aim of the project (thesis) I worked on was to develop efficient techniques for wireless sensor networks with the objective of supporting real-time healthcare monitoring and thus enhance public health service delivery in general by addressing the following key issues related to cyber healthcare systems: 1) Cyber healthcare systems' field readiness 2) Cyber healthcare systems' communication 3) Cyber healthcare systems' interoperability 4) Cyber healthcare systems' security

Design and Implementation of Robust Routing and Forwarding Protocol Providing Reliable Up-links for Weather Data Delivery: A Case Study from Tanzania

Emmanuel A. Kondela, Tanzania

- The purpose of this proposal aims at designing and implementing an uplink(s) routing protocol, that will contribute to improve weather data delivery over reliable uplink(s). Assuming a set of Automatic Weather Stations (AWS) are installed in remote areas with several uplink(s), the proposal will look into robust and reliable uplink(s) for delivering the weather data to a remote central repository. We intend to accomplish the data transfer using a number of different and affordable uplinks including wired and wireless links of different sorts, satellite and sneakernet. Our study addresses the question how to design and implement robust up-links between a remote wireless sensor network consisting of AWS-nodes and a central repository, in order to ensure timely and reliable delivery of weather data. Since most of the available links are unreliable, we are particularly interested in exploring heterogeneous adhoc network solutions, routing data into any intermittently available link. Therefore, our objective is to design a robust routing and forwarding protocol providing reliable up-links, as well as a power-lean and affordable implementation of this protocol.

IoT Spectrum Occupancy

Kiara Navarro, Panama

- Nowadays, there is an increasing need to utilize the frequency spectrum in several fields and services such as education, transportation, agricultural, healthcare, and energy. Due to the spectrum scarcity problem, unlicensed wireless technologies such as Bluetooth, WiFi, SigFox, LoRa have been forced to use the same frequency bands. Thus, to meet the fast growing demand in the use of frequency spectrum in the unlicensed ISM bands, it is important to understand and analyze the impact of frequency interference issues. This research proposes the creation of a low-cost, and energy efficient hardware prototype based on Software Defined Radio and Single Board Computers to measure, process and analyze data in wireless communication interference scenarios.

FlexBox

PONCE DE LEON BARIDO Diego, Mexico

- I will present the preliminary results of a small randomized pilot exploring the potential for energy flexible loads, and demand response (DR), to provide a cost-effective strategy to manage Nicaragua's large wind energy penetrations, and help solve the intermittent supply and demand matching problem that currently exists in the country. I'll present the "FlexBox", a wireless sensor gateway that was composed of ambient temperature sensors and thermocouples, magnetic door switches, plug-load energy monitors, electric current clamps installed on the household's electrical panel, 3G modems, and raspberry pi 3B's that aggregated, stored, and transmitted data. The FlexBox also provided project participants with both monthly paper energy reports and real time energy management suggestions to reduce consumption. Thirty micro-enterprises (MEs) with large cooling loads (freezers and refrigerators), such as butcheries, chicken shops, and mini-markets received a FlexBox, and 30 were used as a control. Timestamped data from participating households was sent to a cloud server and aggregated with open access grid data (e.g., wind energy data). Our project was the first successful micro-level demand response project in Latin America and has opened several other opportunities for exploring how ICTs and IoT can be used for building more inclusive smart grid systems. Although we are currently evaluating impact, we are observing 5%-10% energy savings based on our behavioral based energy efficiency intervention, with high participant engagement in our daily demand response events. Our project will in the near-future allow us to scale the intervention to 200 households in Managua, Nicaragua.

The Dynamic Policy License

SAINT Martin, USA

- Electromagnetic spectrum for wireless communications is fully allocated by regulatory authorities, but this does not mean that it is fully utilized. Demand for greater capacity and new services requires new models for spectrum sharing. We develop a regulatory model denoted the dynamic policy license. The dynamic policy license combines the assurances to licensees that come from holding a fixed license while maintaining regulatory flexibility. A dynamic policy license is similar to a traditional spectrum license that specifies a bandwidth, power, center frequency, location, and other parameters. However, one or more of these parameters is subject to change by the regulator over time. The allowed changes are restricted by the license to provide assurances and predictability to the licensee. The opportunities and challenges that this presents to both regulators and licensees is described. For instance, the dynamic policy license can be a regulatory tool for more aggressive spectrum sharing.

Soil pH and macronutrient electronic sensing system Based on ISFET Sensor and Compensation Techniques

*TAYLOR George Washington
Archbold, Colombia*

- When discussing agrochemicals, we can refer to the use of herbicides and pesticides to control pests and weeds, and fertilizers as synonyms of the forced improvement of the nutritional levels of agricultural soil interceding on plant growth. Although the criteria for the formulation of herbicides and pesticides depends, for example, on inspection and visual field analysis, the formulation of fertilizers is a bit more delicate because it requires detailed and accurate nutritional status of crops, which in turn comes from the lab analysis of soil. However, sometimes these soil tests are not performed or simply are not given the correct frequency, which directly influences the production costs and environmental pollution (soil and air) due to excess fertilizer. In this sense, the agricultural sector requires the implementation of technological solutions that allow soil analysis (sodium, nitrate and pH). These solutions can generate a greater number of data (at a lower cost) compared to soil analysis laboratory routine methods. The research focuses on the development of an electronic measurement platform for N (nitrates), K (potassium) ions and pH levels present in agricultural soils. Likewise, the work assesses the accuracy of this platform, which is based on ISFET sensors (Ion Selective Field Effect Transistor) considering the intrinsic agri-environmental and electronic disturbances.

Carbon Nanoparticle Synthesis Station

TABARES Lorenzo Hernandez, Cuba

- A carbon nanoparticle synthesis station by means of electric arc discharge in liquids is presented. The station was designed to start synthesizing nanomaterials at the CEADEN 's facilities, to gain know-how in this type of novel research as well as to have access to some types of nanoparticles. The synthesis station is composed of a power supply, micro-positioning system, synthesis chamber, cooling system, ballast resistor, two carbon electrodes and a control system. The obtained carbon nanomaterials have been properly characterized. Some experiments in improving the arc current stability and control are presented.

Open source tools used in a hybrid TVWS-WiFi wireless mesh network

ZLOBINSKY Natasha, South Africa

- Developing regions have a challenge in extending internet access to more remote areas far from urban hubs. The profit motive does not exist for ISPs or mobile provider's to build infrastructure in these areas. This results in the inhabitants falling behind educationally and losing out on the opportunity for socio-economic development that internet access enables. To address this problem we are building a low cost wireless infrastructure mesh network to bring internet access to these areas in a cheaper way using alternative wireless technologies and open source platforms. Cloudlets are placed at the network edge for localised content sharing to reduce the cost for content that is popular in the area. The mesh nodes of the infrastructure network communicate using a mix of TVWS and WiFi spectrum bands and we are developing novel MAC algorithms that take into account the complexities of this unique situation. We are working on improving the security and investigating the trust and privacy issues particularly as they relate to community networks and shared content. The network is already providing internet for a non-profit organization that is a learning centre where students can complete their homework research and gain new skills, as well as a school both in townships on the outskirts of Cape Town South Africa. This network can be extended for other applications including various IoT applications.