Wearable Developments in Ecological and Industrial Context in Brazil

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Who I am

- Saul Delabrida
 - Graduated in Computer Engineering (2006)
 - Master Computer Science(2012)
 - Ph.D. Candidate (2015-Current)
- My previous Work
 - IT Manager
 - Software Developer
 - Professor at Computer Department (current)
- My on line CV http://lattes.cnpq.br/3196052576107598

Research Area

- Ubiquitous Computing
 - Graduation Research Wireless Sensor Network (WSN) Protocol
 - Master Research A Framework for Development of Vehicular Applications
 - Ph.D. Research (current) Wearable, User Experience and Industry 4.0
- Main Research Interest
 - Industry 4.0
 - Wearable for Industry
 - Wearable and Industry 4.0
 - User Experience
- My skills
 - Software and embedded hardware configuration and development
 - Development of embedded OpenCV algorithms
 - Linux Yocto Framework for embedded devices
 - Hardware performance evaluation
 - Unity and 3D interfaces

Where am I from

- Ouro Preto (Dark Gold) City
 - Historical Brazilian City
 - Federal University of Ouro Preto



- ~15,000 students of 46 graduation courses and 54 post graduation
- 3 Campis (Ouro Preto, Mariana and João Monlevade)







I can share more with you later

• <u>About UFOP</u>

- <u>https://www.youtube.com/watch?v=HyFje1nEbrg</u>
- <u>About Ouro Preto</u>
 - <u>https://www.youtube.com/watch?v=w_pQX8te1mA</u>
 - <u>https://www.youtube.com/watch?v=nC-VMS-8lwk&t=9s</u>
 - <u>http://2013ritemail2014.blogspot.com.au/2013/04/ouro-preto-outstanding-baroque.html</u>

Where we are



Our Current Reserches

Wearable for Ecology

General Idea



Wearable for Ecology – First Step

- We would like make wearable developments, research and innovation
- We are not interest in create wearable for specifically for health
- Motivated by Samarco Brazilian Company which was supporting many types of research projects
- We had no budget for this project in the begin
- We developed our first prototype based on a my Brazilian friend Geologist master student



Wearable for Ecology - Environment Collector



HDM Component (User View)



Passive Sensor Board (PSB)



Intelligent Sensor Board (ISB)

Wearable for Ecology - Environment Collector





First User Interface

← Passive Sensor Board (PSB) with 14 sensors connected



First Prototype Version







More about the Prototype

Distance Algorithm of ISB



Stage 1 - Cut Image
Stage 2 - Hue and Lightness Filter
Stage 3 - Intersection between H and L channels
Stage 4 - Edge Detection
Stage 5 - Circles Detection
Stage 6 - Moving Average

This algorithm perform in Intel Edison equipment online

Papers Related to this prototype

- DELABRIDA, SAUL; D'ANGELO, THIAGO; OLIVEIRA, RICARDO A.R. ; LOUREIRO, ANTONIO A.F. . Building Wearables for Geology. Operating Systems Review, v. 50, p. 31-45, 2016.
- DELABRIDA, S.; D'ANGELO, THIAGO; OLIVEIRA, RICARDO A. RABELO; LOUREIRO, A. A. F. . Wearable HUD for Ecological Field Research Applications. Journal on Special Topics in Mobile Networks and Applications, v. 21, p. 1-11,2016.
- DELABRIDA, SAUL; D'ANGELO, THIAGO; OLIVEIRA, RICARDO A. RABELO. Fast prototyping of an AR HUD based on Google Cardboard API. In: the 2015 ACM International Joint Conference, 2015, Osaka. Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers UbiComp '15. New York: ACM Press, 2015. p. 1303-1306.
- DELABRIDA, S.; OLIVEIRA, RICARDO AUGUSTO RABELO ; D'ANGELO, THIAGO ; LOUREIRO, A. A. F. . Towards to a Wearable Device for Monitoring Ecological Environments. In: V Brazilian Symposium on Computing Systems Engineering, 2015, Foz do Iguacu. V Brazilian Symposium on Computing Systems Engineering, 2015.
- DELABRIDA, S.; D'ANGELO, THIAGO; CARVALHO, E. ; LOUREIRO, A. A. F.; OLIVEIRA, RICARDO AUGUSTO RABELO; BILLINGHURST, M.; THOMAS, B. A Low Cost Optical See-Through HMD - Do-it-yourself. In: 15th IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 2016,

Wearable for Ecology - Environment Reconstructor – Tree Climber





Steps for this Case Study

- To scan 3D leaves (plain pictures can give only 2D measurements)
- Import them in a 3D modelling tool
- To construct the Virtual Cylinder





Final Result



VR/AR Application for user Interaction





We discussed some challenges, research limitations and open problems

- 3D scanning for demands improvements for this particular case
- We used a Lenovo Phab2 with Google Tango (Depth camera)
- A user study case need to be done
- This technique can used for academics purpose
- The main goal is to have a tagged database for further automatic counting
- Multiplayer application can be investigated
- Demo video <u>https://www.youtube.com/watch?v=Pk0_vhC4IPw</u>
- Paper: Delabrida, S., Billinghurst, M., Thomas, B., Rabelo, R., Ribeiro, P.. Design of a Wearable System for 3D data Acquisition and reconstruction for tree climbers – SIGGRAPH 2017 – To appear

Industrial Development

Belt Conveyor Monitoring System

Industry-Academic Partnership



Belt Conveyor Monitoring System

- This project is sponsored by Vale Mining Company
- The goal is to provide an integrated system for monitoring conveyor belt systems
- They have more than 2.000 belt conveyors systems with \sim 1.6 millions rollers
- Extension: ~1.000 km of belt in all operations (340km at Ports)
- Annual spending of R\$50 millions (~AUD \$20.83 millions)
- This is an (almost) 1 year project

Belt Conveyor Monitoring System









Belt Conveyor Systems components



Proposed Solution and Architecture

More details to appear on ICEIS'17:

Function/Tool		UI Interface	Layer Name	
Data Analysis		Strategic Analysis	Knowledge Discovery	
Maintenance Planning		Operational Analysis	ERP/CMMS	ł
Enterprise Service Bus (ESB)	IoT Interface		Legacy Systems Integration	ers
Enterprise PIMS		Operational Analysis	Storage	em Lay
Data Center Processing Unity	Mobile Processing Unity	Real Time Information	Sensors Data Extraction	Syste
Mobile Sensors	ance Module _	Data Capturing Assistance Module		

Nascimento R., Carvalho R., Delabrida S., Bianchi A., Oliveira R. and Garcia L. (2017). An Integrated Inspection System for Belt Conveyor Rollers - Advancing in an Enterprise Architecture. In Proceedings of the 19th International Conference on Enterprise Information Systems - Volume 2: ICEIS, ISBN 978-989-758-248-6, pages 190-200. DOI: 10.5220/0006369101900200

Assistance Module

- Work Teams:
 - Drone Developments (Drone Simulator/Drone Device)
 - Digital Image Processing and Digital Signal Processing Developments
 - Embedded Hardware Developments
 - User Interface Developments

- Project Staff
 - 3 undergraduate students
 - 4 Master students
 - 2 Doctoral students
 - 4 Ph.D. researchers



Sensing – Thermal Case – Paper submitted





Mobile Users' Interfaces - Paper submitted

Challenge: To provide users' interface for real time workers interaction





St Lat: 76.6772 Long: 154 323 Lat: 76.6772 Long: 154.3235

1- Drone compass

CICE COMMAND

- 2- Area Map
- 3- General Data

Voice Command for enabling the user interface functions

Other Researches

Wearable and Industry

Wearable in The Loop (WITL)





Other Researches

- Rogue Drones Intrusion Drones detection in a port area Master Student
- Belt Conveyor components classification Master Student
- A Constraint-Driven Assessment of Operating Systems for Wearable Devices. VJP Amorim, S Delabrida, RAR Oliveira - Computing Systems Engineering (SBESC), 2016
 Vicente Amorim – Ph.D. Candidate
- Energy Efficiency in Industry 4.0 using SDN Theo Ph.D. Candidate
- Belt Tear Monitoring Master Student

Wearable Book

Topics Covered

The many academic areas covered in this publication include, but are not limited to:

- Augmented reality
- Cancer Detection
- Internet of things (IoT)
- Kinetic Energy
- Smart Cities
- Stroke Monitoring
- Thermophysiological Comfort



Examining Developments and Applications of Wearable Devices in Modern Society



Thank you for watching!

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