Collaborative Human Activity Recognition

| Alberto Gimenez  Facultad Politécnica - UNA  San Lorenzo, Paraguay  albergimenez@gmail.com | Santiago Yegros  Facultad Politécnica - UNA  San Lorenzo, Paraguay  santiago.yegros@gmail.com | Joaquín Lima  Facultad Politécnica - UNA  San Lorenzo, Paraguay  joaquin.lima@pol.una.py |
| --- | --- | --- |

# ABSTRACT

Human Activity Recognition (HAR) is a research topic broadly covered in the last decade for its relevance in areas where the users context is important to build interactive applications. Smartphone applications have the capability to collect data from the environment and along with algorithms that take advantage of context-aware information becomes a powerful development platform. In this paper, we propose a HAR System denominated HARDroid, that is specifically designed to detect common user activities. Furthermore, data collected from users on ground are taken into account to improve the activity recognition classifier. HARDroid is freely available as a library that may be included in Android applications. Finally, an evaluation that comparing the initial classifier with an improved classifier is presented, achieving a recall of 91% and a precision of 92%.

## Author Keywords

## Location-Aware/Contextual Computing; Collaboration; Mobile Devices: Phones/Tablets; Quantitative Methods; Prototyping/Implementation; Machine Learning; Sensors Wearable Computers; Contextual Inquiry; Survey; Artifact or System Dataset.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See<http://acm.org/about/class/1998>for the full list of ACM classifiers. This section is required.

# INTRODUCTION

Human Activity Recognition (HAR) is a research topic in constant development for more than a decade and that covers the design of algorithms that collect data from people interacting with their environment to provide contextual information [1]. The common example of using these algorithms is to recognize basic ambulatory activities, which are, when an individual is walking, running, standing or sitting, all through some type of sensor or camera available for that purpose.

As smart mobile phones began to become more widespread, HAR-based applications have been propitious to be developed in order to determine user interactivity and interact with them. This allows the use of contextual information available for various purposes such as: data mining and predicting activities for various types of intelligent applications in different fields, for example in medicine, security, entertainment or military use, etc. [2].

The usual sensors in a smartphone are varied and may include: a GPS (for location), microphones, cameras, luxometer, thermometer, barometer, compass and accelerometer. There are also other sensors more varied depending on the model, manufacturer or accessories that can be paired with the device. The accelerometer is the most common sensor in these devices and can measure the movement in two or three axes as well as detect the orientation of the device. The main use of provided sensors information is the recognition of human activities.

Along with the above, there has also been a breakthrough in the state of the art for the human activities recognition with sensors. This includes: recognition techniques, methods of data capture and signal processing, and the application of artificial intelligence techniques such as Machine Learning [3], [4].

On the other hand, despite the large amount of software and applications that have been developed in the field of human activities recognition, there is still a lack of a software HAR component that can be extensible and be available for free use or for its improvement. That is, without relying on private Application Programming Interfaces (APIs), Software as a Service (SaaS) platforms, or third-party applications of free use but of closed definition, such as Google Play Services and Apple Health Kit, among others.

This proposal contemplates the study of the human activity recognition techniques on smartphones with focus in provide a HAR system in the form of a library that is free to use or to improve. Moreover, interactive user participations are taken into account to do a collaborative improve of the recognition classifier. The generated components are validated through experimental tests and the collected data shows the effectiveness of the resultant library.

# STRUCTURE OF HAR SYSTEMS

The styles contained in this document have been modified from the default styles to reflect ACM formatting conventions. For example, content paragraphs like this one are formatted using the Normal style.

## Data collection

Headings of subsections should be in Arial 9-point bold with initial letters capitalized (Heading 2 style). For sub-sections and sub-subsections, a word like *the* or *of* is not capitalized unless it is the first word of the heading.

## Processing

Headings of subsections should be in Arial 9-point bold with initial letters capitalized (Heading 2 style). For sub-sections and sub-subsections, a word like *the* or *of* is not capitalized unless it is the first word of the heading.

## Learning and classification

Headings of subsections should be in Arial 9-point bold with initial letters capitalized (Heading 2 style). For sub-sections and sub-subsections, a word like *the* or *of* is not capitalized unless it is the first word of the heading.

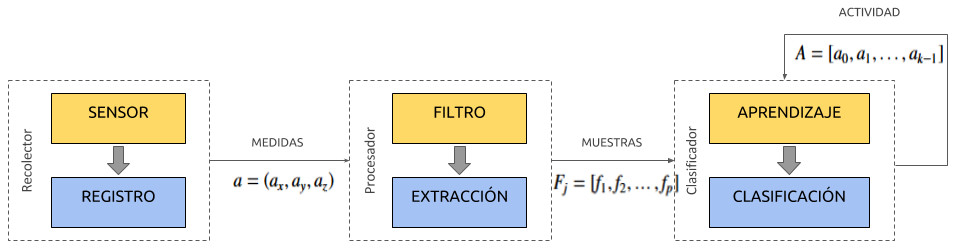


Figure 1. General structure of human activity recognition.

# HARDROID

The styles contained in this document have been modified from the default styles to reflect ACM formatting conventions. For example, content paragraphs like this one are formatted using the Normal style.

# EXPERIMENTAL RESULTS

The styles contained in this document have been modified from the default styles to reflect ACM formatting conventions. For example, content paragraphs like this one are formatted using the Normal style.

# Conclusion

It is important that you write for the SIGCHI audience. Please read previous years’ proceedings to understand the writing style and conventions that successful authors have used. State clearly what you have done, not merely what you plan to do, and explain how your work is different from previously published work, i.e., *the unique contribution that your work makes to the field*. Please consider what the reader will learn from your submission, and how they will find your work useful. If you write with these questions in mind, your work is more likely to be successful, both in being accepted into the conference, and in influencing the work of our field.

# ACKNOWLEDGMENTS

Sample text: We thank all the volunteers, and all publications support and staff, who wrote and provided helpful comments on previous versions of this document. Authors 1, 2,and 3 gratefully acknowledge the grant from NSF (#1234-2012-ABC). This is just an example.

# REFERENCES

1. @\_CHINOSAUR. 2014. VENUE IS TOO COLD. #BINGO #CHI2016. Tweet. (1 May, 2014). Retrieved February 2, 2014 from https://twitter.com/\_CHINOSAUR/status/461864317415989248
2. ACM. How to Classify Works Using ACM’s Computing Classification System. 2014.Retrieved August 22, 2014 from [http://www.acm.org/class/how\_to\_use.html](http://www.acm.org/class/how_to_use.html )
3. Ronald E. Anderson. 1992. Social impacts of computing: Codes of professional ethics. *SocSciComput Rev* 10, 2: 453-469.
4. Anna Cavender, Shari Trewin, Vicki Hanson. 2014. Accessible Writing Guide. Retrieved August 22, 2014 from <http://www.sigaccess.org/welcome-to-sigaccess/resources/accessible-writing-guide/>
5. Morton L. Heilig. 1962. Sensorama Simulator, U.S. Patent 3,050,870, Filed January 10, 1961, issued August 28, 1962.
6. Jofish Kaye and Paul Dourish. 2014. Special issue on science fiction and ubiquitous computing. *Personal Ubiquitous Comput*. 18, 4 (April 2014), 765-766. <http://dx.doi.org/10.1007/s00779-014-0773-4>
7. Scott R. Klemmer, Michael Thomsen, Ethan Phelps-Goodman, Robert Lee, and James A. Landay. 2002. Where do web sites come from?: capturing and interacting with design history. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '02), 1-8.<http://doi.acm.org/10.1145/503376.503378>
8. Psy. 2012. Gangnam Style. Video. (15 July 2012.). Retrieved August 22, 2014 from <https://www.youtube.com/watch?v=9bZkp7q19f0>
9. Marilyn Schwartz. 1995. *Guidelines for Bias-Free Writing.* Indiana University Press.
10. Ivan E. Sutherland. 1963. *Sketchpad, a Man-Machine Graphical Communication System*. Ph.D Dissertation. Massachusetts Institute of Technology, Cambridge, MA.
11. Langdon Winner. 1999. Do artifacts have politics? In *The Social Shaping of Technology* (2nd. ed.), Donald MacKenzie and Judy Wajcman (eds.). Open University Press, Buckingham, UK, 28-40.