"Human activity monitoring using gas sensor arrays (Fonollosa, Rodriquez-Lujan, Shevade, Homer, Ryan, & Huerta, 2014)"

A Synopsis

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Introduction

This synopsis summarizes a research paper describing the construction and testing of a gas sensor array used to monitor human activity. It is written by Jordi Fonollosa, Irene Rodriques-Lujan, Abhijit V. Shevade, Margie L. Homer, Margaret A. Ryan, and Ramon Huerta and was published in "Sensors and Actuators B: Chemical" in 2014. In this paper, Fonollosa, et al, research the possibility of using their sensor array, which is designed to monitor human activity in the confinements of the International Space Station (ISS), to monitor the activity of older adults in their homes in hopes of triggering early intervention if monitored behaviors indicate the onset of illness or distress (2014, p. 398). The results of their research suggest that a gas sensor array could be used in lieu of accelerometer/gyroscope systems, which must be worn, and video monitoring systems, which can invade privacy (2014, p. 401).

Fonollosa, et al, focused their experiment on monitoring the environment and chemical changes inside a spacecraft simulator and using their data to predict the number of people present at a given time and the types of activities they were performing.

Summary of Research

JPL researchers deployed their Enose sensor array in the Regenerative ECLSS Module Simulator, known as REMS, at NASA's Marshall Space Flight Center. The Enose sensor is composed of several polymer-carbon composite sensing films which are fabricated by soaking a ceramic substrate in a solution of carbon black dissolved in solvent containing insulating polymers. When the solvent evaporates the substrate is coated with a semi conductive layer of carbon suspended in a polymer matrix. The resistivity of the matrix changes in the presence of different gases as the polymer expands or contracts, thus moving carbon molecules closer together or further apart. The Enose sensor used in the experiment was capable of measuring eight organic and three inorganic species of molecule. The sensor array was positioned near an air uptake vent to allow for the detection of molecules located anywhere in the test chamber (Fonollosa et al., 2014, p. 399).

The REMS is a 200 m^3 simulation chamber that operates at a controlled pressure of 1 atm and temperature of approximately 21°C . Volunteers for the experiment included 15 females and 47 males who entered and exited the REMS at different times and performed various activities; such as cooking, exercising, bathing, etc. A strict log was kept of who entered, what time they entered, what they did while inside, and what time they left. The collected dataset included readings over the course of four weeks and consisted of 960 data points (2014, p. 399). The dataset was divided into two groups. The first group, called the training set, was collected over the first two weeks. The second group, called the test set, was gathered over the last two weeks. The training set was used to develop prediction models and test set was used to test those models. Two prediction models were developed. The first model was used to predict the number of people present in the chamber. The second model was used to predict the number of individuals who were exercising. Both models were tested with the test dataset to verify that the models were capable of making accurate predictions (Fonollosa et al., 2014, p.400).

Conclusion

The researchers found that their models tended to overestimate the number of people present as the number of people increased. They believed that this was the result of sensor drift since the magnitude of the overestimation increased over the course of the experiment. However, they were able to account for this by updating the baseline daily during periods when it was known that there were no people in the room. The Root Mean Square Error of the predicted number of people in the chamber versus actual for the total number of people was 0.99; for the number of people exercising it was 0.43 (Fonollosa et al., 2014, p. 400). Results from the experiment verified that their gas sensor array was capable of accurately predicting the number of people present and the number of those individuals who were exercising (see Figures 1 and 2 below). The researchers were also able to determine that one of the individuals was using a topical medication based on ethanol measurement data; verifying the sensor array’s ability to detect unexpectedly high concentrations of certain volatile organic compounds (2014, p. 401).

The implications of these results are that it may be possible to monitor the activities of older adults and determine some of their activities. It may also be possible to detect changes in their health by measuring unexpectedly high concentrations of certain volatiles. The development of more specialized models may help older individuals to live independently longer, without the use of invasive technologies (Fonollosa et al., 2014, p. 401).

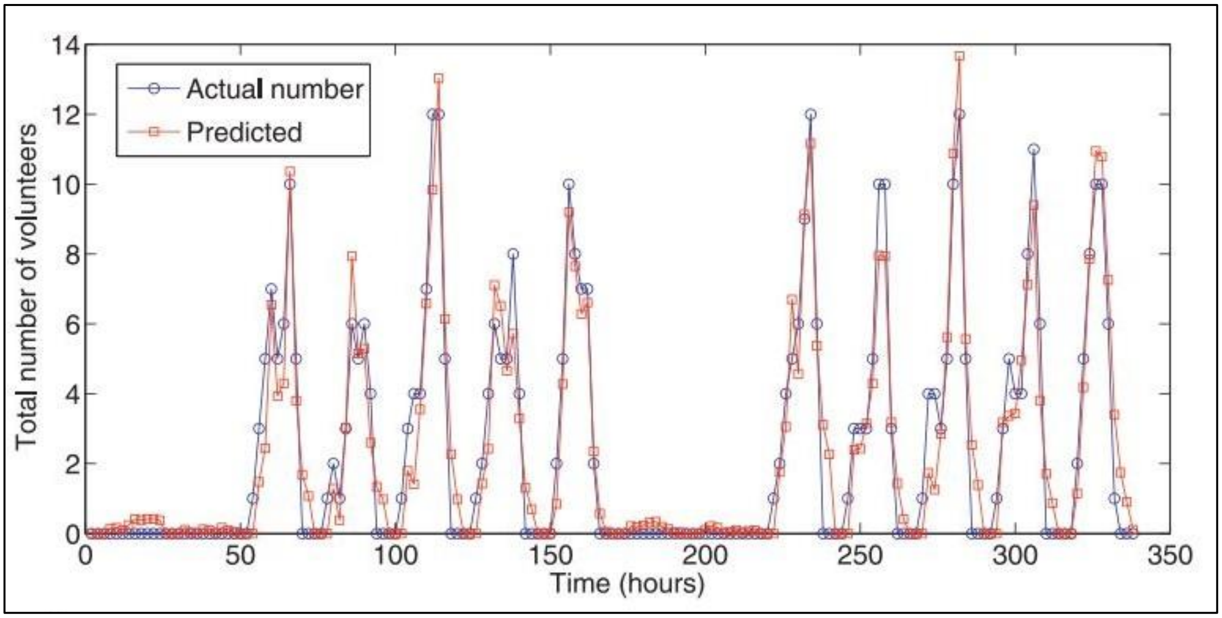

Figure 1: Baseline Corrected Predictions Versus Actual Number of Individuals in the Chamber. This figure illustrates comparison to the test dataset which was gathered during the last two weeks of the experiment. (Source: Fonollosa et al., 2014, p. 400)

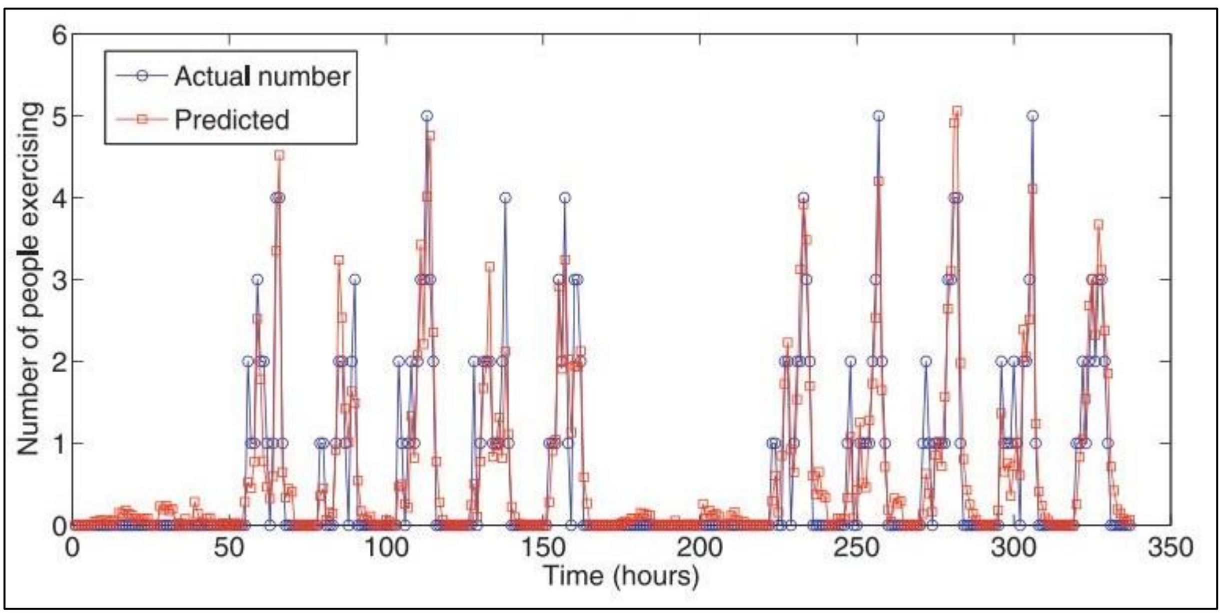

Figure 2: Baseline Corrected Predictions Versus Actual Number of Individuals Exercising in the Chamber. (Source: Fonollosa et al., 2014, p.400)

Works Cited

Fonollosa, J., Rodriquez-Lujan, I., Shevade, A. V., Homer, M. L., Ryan, M. A., & Huerta, R. (2014). Human activity monitoring using gas sensor arrays. *Sensors and Actuators B: Chemical* , 398-402.