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Detecting Social Interaction in a Smart Environment

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Background: Over the last few decades, numerous articles and studies have shown the relationship between loneliness and its effects on people's health, especially in the case of senior citizens. Detecting loneliness requires a meticulous and continuous observation of the subject by clinicians. However, considering the growth of the population over sixty, the huge demand for health-care facilities, and the necessity to contain the costs of hospitalization, the technology is now called to support the activities of specialists. An open challenge is to measure the level of social interaction among people, and to infer a personal "loneliness" index. We propose a system to identify the interactions among people who are sharing the dining table in a smart environment.

Method: This study refers to an experimental investigation conducted in "Il paese ritrovato", an innovative health-care facility located in Monza, Italy, that assists people affected by Alzheimer Disease. The system detects the patients who are sitting around a table and their position; this information is computed integrating an environmental Bluetooth indoor localization system and an RFID module installed on the table. Moreover, the system detects the social interactions: a quad-microphone array expansion board for Raspberry Pi called ReSpeaker Mic 4-Array detects the direction from which someone is speaking. A dedicated software filters the data locally, and computes a "social index" among the people who are sitting around at the table. The communication between the main module and the devices has been implemented using MQTT, a publish/subscribe mechanism.

Key results: The experiment has been carried out in an indoor environment, by placing the system on a four-sided square table with four people, one for each seat. During the testing phase, the system has been tested under three different environmental conditions: in absence of noise and voices aside from the speaker, in presence of noise and with other people speaking in the surroundings of the system. Overall, the system shows promising results (precision: 84%, recall: 93%, accuracy: 79%) only, in presence of loud noise, the system is still not able to identify with precision the people who participate in the interaction. We strongly believe that the computed index constitutes a valuable source of knowledge for further data analysis modules (such as the one installed in "Il paese ritrovato") to monitor patients.

Conclusion: A novel system to identify the interactions among people who are sharing the dining table in a smart environment has been presented. Thanks to a localization module based on both Bluetooth and RFID technologies, and a microphone, this system is capable to measure the level of social interaction among people. As future work, we plan to investigate the possibility to extend the system to detect social interactions in wide open spaces through the integration of a device capable of recognizing the speakers' voiceprints.

Keywords: Wellbeing assessment, Assistive Technologies, Social interaction, Smart Environments, IoT.

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Tweetable abstract: The study proposes a novel technological system to measure the level of social interaction among people sharing the dining table in a smart environment. This system has been specifically designed to infer a personal "loneliness" index in patients living in a health-care facility.