In the new IoT era, many types of sensors can now monitor our daily lives, changing the way we think about multimedia and its role in society. Multimedia is no longer confined to documentation and preservation, entertainment, and personal media collections; rather, it has become an integral part of the tools and systems that are providing solutions to today’s societal challenges—including challenges related to health, aging, education, societal participation, sustainable energy, and intelligent transportation. Multimedia has evolved into a core enabler for future interactive and cooperative applications at the heart of society.

The goal of the MMHealth 2017 Workshop on Multimedia for Personal Health and Health Care was to explore the relevance and contribution of multimedia in healthcare and personal health. After a successful debut in Amsterdam in 2016, the second workshop at ACM Multimedia 2017 in Mountain View, California, again attracted more than 30 participants, indicating the relevance that this topic has in the multimedia research community.

The workshop is deliberately interdisciplinary and aims to give a clear home to multifaceted topics in which domain expertise meets multimedia research questions. These topics are also reflected in the organizers’ areas of expertise.

KEYNOTE

The keynote by Noel E. O’Connor and Alan Smeaton (see Figure 1) presented exciting opportunities in personal, long-term multimedia health data analysis. Today, we often merely count steps taken, measure distance walked, add up energy expenditure, and assess sleep quality. However, there is so much more to personal health that we are only now starting to measure.

Human lifestyles have built-in periodicities of various frequencies: daily, weekly, monthly, seasonal, and annual. The 24-hour periodicity is the most important and dominant, and disruptions to our 24-hour periodicity do cause us harm. Using wearable sensors to collect data, we can not only detect these periodicities, but also measure the strength or intensity of the 24-hour periodicity over a time period.
A study gathered wrist-worn accelerometer data from 20 people over a three-month period and measured the strength of their 24-hour periodicity. The analysis found correlations between shifts in periodicity intensity and relevant cardio-metabolic biomarkers. This is an extremely exciting result, potentially showing how highly relevant cardio-metabolic health feedback can be generated based on very simple and seemingly unrelated sensor data. The example highlights the fact that we have much more to do to really maximize value from personal sensing data.

![Figure 1. Noel E. O'Connor gives the keynote at MMHealth 2017.](image)

**PROGRAM**

The workshop program comprised talks on nine full papers and an interactive poster session with seven short papers from the authors of main-track papers (see Figures 2 and 3).

Analyzing different types of data was one of the major topics of the workshop, with discussions on a broad range of data types such as measurements from brain-computer interfaces, throat microphone recordings, and Microsoft Kinect sensor data. Another focal point was systems and applications, ranging from an impressive universal self-care “Tricorder” to gamification approaches in physiotherapy. Finally, the workshop touched on cross-topic issues such as challenges in interdisciplinarity and long-term studies.

![Figure 2. The poster session at MMHealth 2017.](image)
DISCUSSION AND OUTCOMES

The presentations triggered a lively discussion around research challenges, methodologies, and boundary conditions (see Figure 4).

Six central themes evolved:

**Devices and sensors** are the source of the multimedia data that we analyze to understand health. Numerous sensors exist that we can make use of, as the examples in the keynote showed. On the other hand, hardware and sensors, as well as the associated APIs, should be standardized to facilitate general and easy access to all data.

It is clear that health-related data and health media provide great opportunities; however, we see big challenges in **big data** in terms of collecting and analyzing low-level sensor data. How can we gain personal health insights from the data and extract valuable and relevant insights for individuals and large populations? With the new learning approaches we see in the field, we should consider visualizing methods that will allow validation of information extraction and learning.

One main challenge for research in this area is that collecting sufficiently large sets of long-term data is extremely costly. We would therefore need **open datasets** of annotated long-term data that could be used for benchmarking and large-scale studies in mobile health. However, it was agreed that setting up such a dataset would be a major effort. This would further be challenged by the fact that “long-term” may be defined differently in different health domains, and requirements on the data would be highly diverse.

We must also consider all **relevant stakeholders** when designing and developing next-generation health systems. In our approaches, we should consider early and continued patient involvement. Specifically, as we are addressing an ageing society, we need to embrace the users’ needs and requirements. Moreover, we have to take into account all stakeholders, both on the professional healthcare side and the personal side (parents, relatives, and friends).
There was a strong agreement that interdisciplinary approaches to this research are highly valuable. However, it is challenging to bring together medical and multimedia practitioners for system design and evaluation, as well as to convince the medical community—with its very different research traditions and cultures—to actually take up the results. Moreover, interdisciplinarity comes at a price, including but not restricted to considerably higher efforts. It takes a lot of time and resources to achieve results that have sufficient depth from a technical research standpoint—innovative and publishable, but also broad enough to deliver sustainable and applicable solutions.

When collecting health media and potentially sharing them for research purposes, we must openly address legal issues related to publishing patient data in the research community. Even though the collection and availability of large amounts of data is crucial for driving future healthcare, we must be very careful with data that is so important and sensitive.

CONCLUSION

The MMHealth workshop thrived in its second year (see Figure 5). The number of submissions and participants indicates the multimedia community’s increasing interest in health as a research topic. Health and healthcare are highly relevant societal topics, and the technological developments of the past few years provide tremendous opportunities for new approaches to tackle the related challenges. We are confident that this workshop furthered understanding of how multimedia could move towards health-related topics in the future.
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