ITaaU Network

Review of the literature on the area of Internet of Things (IoT) applied to aspects of the safety and security of the Food Network

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The Internet of Food Things

Executive summary

Technology in general, and the Internet of Things (IoT) in particular, has considerable potential for assisting with food safety and, to a lesser extent, food security. A significant prospect for food safety in the capability to extend automation through "from farm to fork", owing to the growing recognition that it is the data created and the use made of it that is significant, rather than the details of the technology deployed. However, to date the published academic evidence relates much more to architecture and design than to extensive system implementations.

The areas that receive the most attention are logistics, supply chain management and, at the production stage, precision agriculture. The emphasis is very much on tracking and traceability, including surveillance. Consumer interests are also a focus area, comprising health and nutrition topics, identifying safety issues, and supporting personal responsibility for diet decisions.
IoT studies have two facets: sensors and other devices; and the deployment of the data that they generate. Standards are emerging, but slowly, which holds back academic appraisal of the methods, impact, and quality of IoT applications. There is a clear need for deeper appreciation of the data needed and what could be achieved by understanding that data.

The literature survey on the role and potential of IoT in the area of food safety was conducted in a progressive manner, beginning with a wide-ranging search, which was subsequently refined to explore specific topics in more depth. Based on the surveys as a whole, the 43 most significant authors were identified and their work highlighted.

The surveys exposed a range of topics of interest, with tracking and tracing being the area in which the potential of IoT was most evident. However, many of the articles proposed architectures but provided little or no indication that the approach had been tested in real practice. Moreover, there were few signs of the emergence of standard good practice. One of the pilot projects used Tinytag™ data loggers to monitor the cold chain for sandwiches and highlighted significant breaches of temperature control, concluding that point measurements are inadequate and a shelf-life profile is more accurate.

Data acquired by precision agriculture applications is used to inform practices and decisions. The search results cover not only system and informatics considerations but also specific resources and produce. However, a significant proportion of the articles are primarily about communication rather than the agriculture data itself.

A significant emerging from the surveys is the deficit of knowledge about what data is needed, rather than the lack of data or ways to collect it. The transparency and provenance of the data will also be important considerations: veracity is one of the four 'V's associated with applications that generate "big data".

IoT can still be regarded as an emerging technology. The technology sections of the media consistently feature stories about smart homes, featuring monitoring and control of heating, lighting, and fridges, but wide scale uptake has been limited, even for the smart meters offered by the power companies. Within the food sector, the greatest impact of IoT has been in transport and logistics: tracking and tracing. As might be expected, other distribution networks use devices to track items in transit. Evaluation of the broad-ranging role of IT in interpreting data to inform actions and mitigate consequences suggests that IoT could help not only with tracking and tracing but also in areas such as surveillance, waste management, and behavioural change. However, it is vital to collect and transfer the correct information. Food now has a very long supply chain, which is like a maze, and the longer the chain, the more things that can go wrong. For IoT to play a useful role it must be equally usable by the consumers, the small producers and marketers as well as big, global, organisations.
The opportunities for IoT to improve food monitoring, product traceability, and consumer trust are conspicuous, as revealed by the research identified during the literature surveys: Appendix F lists specific examples. However, it is important that monitoring is accurate, as shown by the Tinytag™ project. Furthermore, integrating specialist areas into an interoperable framework will require standards, which inevitably take time. Although standardisation work is ongoing, little of it currently appears in the formal academic literature. A key issue to be resolved is the differentiation of the Internet of Things from "sensor networks".

Issues that have emerged during discussions of the literature survey findings include: the lack of trust, aggravated by limited sharing of data; privacy and data protection; the influence of supermarkets and other large organisations, and network complexity, which affects connectivity. The many and varied challenges relate to all these issues, to managing consumer expectations, and – last but not least – data management.

The need for deeper appreciation of the data needed and what could be achieved has already been identified and in part 6 the report makes recommendations with respect to data, behaviour, and technology.

For realistic IoT deployment there is a need for low-cost sensors running widely agreed and interoperable standards and connected with widely available wireless coverage. To ensure consumer trust the IoT systems must be secure, must have demonstrable accuracy in event trending, tracking and monitoring, and be able to cope with failures of the devices, networks and system. The data modeling is key to the use of IoT systems, so that the ability to undertake data integration and fusion is essential while avoiding "Data Obesity ". Consumers will expect that Industry – Government data is available for sharing under appropriate secure conditions, the extent to which this can be extended to consumers highlights the need to address and bridge the "Digital Divide". Managing consumer expectations following all of the above will be essential if the valley of doom in the Gartner Hype Cycle is to be circumvented for the useful deployment of IoT in the food network.