IoT-Aided Charity: An Excess Food Redistribution Framework

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Introduction: **In 2016, it's been revealed that 1 in 6 Australians had to deal with food insecurity in the past 12 months [1]. 33% of those who sought food relief were children. Overall, 8% of increase in people who sought food relief is recorded in 2015. Another report has revealed that 795 million of world's population are undernourished [2]. Food insecurity has both physical and psychological impacts on a person's life which could be short term or long term. Tiredness, loss of weight, loss of focus, exposure to illnesses are some of the physical impacts, and stress, loss of confidence, sadness and loss of hope are some of the psychological impacts on a person's life [1]. In contrast, few other studies have released staggering statistics on food loss and waste both locally and globally [3-5].This clearly indicates that if food loss and waste can be managed efficiently, it will have a large impact in reducing the number of people who are undernourished. Our critical analysis on popular existing non-ICT based systems, ICT based systems and different scenarios has exposed their short comings, strengths and approaches towards dealing in reducing food waste. This paper proposes a novel approach towards efficient food waste reduction via an IoT enabled dynamic and real-time match-making system which addresses the strengths and shortcomings identified in the above mentioned analysis. A Smart Food Container/Smart Container containing different sensors is designed to capture real-time context of food donations made available by the vendors1, to facilitate sharing with consumers2. Although the concepts are proposed for the Food Wastage Management (FWM) domain, our approach can be adopted, customized or extended to manage other resources as well. The structure of this paper is as follows. Section 2 summarizes the strengths and weaknesses of existing ICT based food wastage management systems. The third section describes the overall conceptual architecture of the proposed framework. In the fourth section, we take a deep look into the concept of a Smart Container, a prototype and some results are presented as well. In the final section, a conclusion and future work are presented which foresights the evolution of our proposed system.**

Keywords: **Internet of Things (IoT), Sensors, Food Waste Management (FWM), Context, Context-awareness**

LITERATURE SURVEY

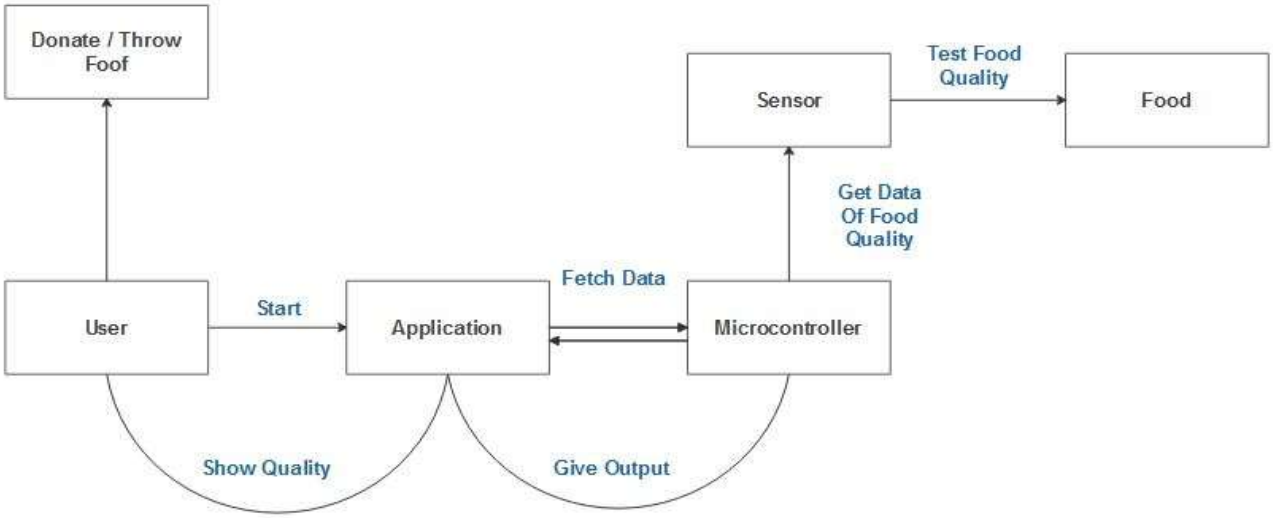
1] Investigation of food freshness sensing technology for consumer use – published in 2016 Progress in Electromagnetic Research Symposium (PIERS) fTo help consumers enjoy healthy food, technology investigation for food freshness sensing are conducted. In this study meat is selected as the detection target based on a consumer survey.

2] Discrimination of chicken freshness using electronic nose combined with PCA and ANN – published in 2014 11th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON) In this study, the E-nose was applied to predict chicken freshness during different storage days. Principal component analysis (PCA) and artificial neural network (ANN) were used to analyze the experiment data

3] Potential of impedance spectroscopy for real-time assessing of food quality – published in 2018 IEEE Instrumentation & Measurement Magazine. Reliable information about food state and freshness throughout production processes and until consumption is very important for product quality, consumer safety and export of goods.

4] Snapshot Multispectral and Hyperspectral Data Processing for Estimating Food Quality Parameters - published in 2018 9th Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS) In this paper, we have developed a processing pipeline for multispectral and hyperspectral snapshot video sensors, towards detecting certain critical quality parameters like freshness, spoilage levels and storage temperatures

SYSTEM ARCHITECTURE



PROPOSED FRAMWORK

The proposed framework consists of four main components which are Virtual Marketplace, Data Management Engine, Recommendation Engine and Trust, Reputation and Fraud Detection and Prevention Engine

A Virtual Marketplace is designed as a platform which facilitates the creation of profiles, registering of requirements and donations, and receiving recommendations. Vendors and consumers can interchange their roles due to the context-awareness of the system and the system not only considers human consumption of surplus food but also other uses such as composting and bio-materials/processing. This is open for all the stages of the Food Supply Chain (FSC). Data Management Engine handles all the data related operations in the system. This enables coexistence and collaboration between systems by importing profiles and transaction data from existing systems to build and enhance profiles. Furthermore, it can automatically extract data from the web and social media with the consent of users to improve the context knowledge of each user, which prevents users from filling lengthy forms at the registration process. In addition, collection of sensor data is handled by this Engine. Moreover, it handles all the data storing, retrieval and update operations. The four databases store profiles, donations related data, transaction history and knowledge gained through analysis for future improvements

Recommendation Engine handles all the match- making between vendors and consumers. An initial match- making is performed based on the profile and requirements of resources by both parties which is continuously monitored and improved based on real-time data extracted from sensors. This is then sent to Analytics Engine to analyze based on the transaction history and knowledge base. After the analysis, optimized recommendations are sent back to the Recommendation Engine where final matching will occur based on this new knowledge and will be sent to the Virtual Marketplace, which will notify interacting parties. This Recommendation Engine considers both vendor's and consumer's requirements when executing the match-making algorithm which aims to guarantee both parties' requirements are satisfied. Analytics Engine will store the new knowledge gained for future references. Existing systems can use this framework as vendors or consumers to find food relief or post donations on behalf of their clients and the match-making will occur between these systems' users and results will be sent to those systems establishing collaboration between them.

CONCLUSION

This paper proposed an IoT based novel, real-time and dynamic framework to efficiently distribute excess food which would otherwise end up in waste lands. This framework addresses the weaknesses identified in the existing systems as well as maintains the strengths they have. The concept and an initial prototype of a Smart Food Container was introduced. Although current focus is on the excess food these can be used to identify the best environment for non-excess food as well as for other resources for donation.

Weight, GPS, Air pressure, Light and RFID readers will be added to the Smart Container in the next phase of the implementation. This will enable to gather more accurate context-data about the Smart Food Container's environment, including actions taken with the food and the condition of the food. Ultimately these allows real-time, dynamic, intelligent and context-aware match-making between the vendors/food items and consumers. In the future, drones (on land or flying) can also pick up such excess food from the Smart Food Containers and help deliver them to matched consumers.

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