

Survey Paper on Intelligent System for Vertical Farming Using Ubiquitous Computing

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Abstract- Over the years, traditional farming for harvesting with the use of soil takes longer time to decompose making it prone to diseases and expensive. Ubiquitous vertical system means growing plants without soil with better results, especially in areas with space and environment unsuitable. Commercial Ubiquitous vertical is the upcoming technology that grows plants through an inert media instead of natural soil. This system has no adverse effects on environment or quality on crops. Its main aim is to save water, improve quality of crops avoiding the adverse effects of pesticides and factors affecting quality of soil and save land.

Indexed Terms- Ubiquitous Computing, Vertical farming, IoT, Arduino, sensors, ML algorithms.

I. INTRODUCTION

The Internet of Things (IoT) is considered as a great opportunity for the development in the information field nowadays, it has been applied widely in many fields.

UBIQUITOUS COMPUTING in agriculture is emerging remarkably in this fast-processing pervasive environment, owing to Wireless Sensor Network (WSN). Building a context aware system for the vertical farm is complex without the semantic interoperability between the Internet of Things (IoT). The increment in the production of agricultural sector is very important for the development of any country. System works on the Internet of things (IoT) based wireless system which transmits the fundamental parameters in real time perceivable through a series of ubiquitous sensors placed inside the experiment.

Vertical farming is a fully automated system without any human intervention, which is also considered as the new agricultural evolution. The word 'Ubiquitous

vertical' defines as any means to grow plants via a medium that does not require soil.

The system is independent of each other. Contextaware service is being realized between the system by using the set ontology that supports the communication.

II. CONTEXT STUDY

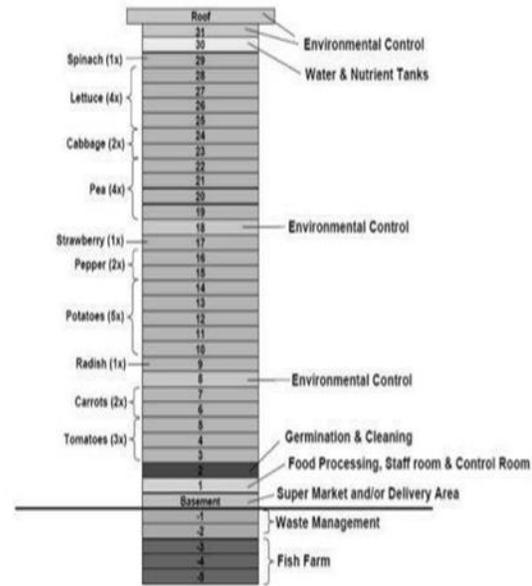
This section represents the background work of the proposed ontology. First, we have discussed about the vertical farming which has both technological and expert engineering that makes a perfect combination for the ubiquitous computing environment. Next, OWL based ontology model is briefly discussed which is considered to be well suited for the development of semantic interoperability and finally the related works that helped in the development of context model. The Ubiquitous-agriculture or intelligent agriculture is one of the applications of Internet of things (IoT). Zigbee standards in the wireless sensor network are recognized as the authoritative standards of agricultural environment [20]. Zigbee uses wireless mesh protocol for wireless control and monitoring and is well known for long-lived battery and high reliability with a low cost and low power [17]. Many studies have been undergone in the u-agriculture focusing mainly on the monitoring and automatic process controlling. Explain the service-based system workflow model of agriculture with a situation context Similarly, a real-time "Field Area" monitoring service in agricultural field was successfully created by Mizoguchi et al. One the importance of wireless sensor network in the context aware middleware of the greenhouse environment [15].

A. *Ubiquitous in Vertical Farming:* Vertical farming is considered as one of the modern agricultural technique in the future urban area, in where most

of the people are expected to live.[12] Agricultural farming took different forms over the millennium since the invention of agriculture in stone ages to which it finally reached the vertical farming. And it may take different dimensions in the future, as the technologies are evolving nonstop. Computer technology during the last decade has numerous changes in the many fields. Looking back the evolution of the computer, in the early ages, the mainframe era was made a big evolution in which only expert accessed the computer.

B. *Overview:* But today, the popular devices as laptops, tablets and Smartphone are owned and accessed by all ages. The third wave of computing (Ubiquitous computing) is already upon us, leading to the departure of mainframe and personal computer.[15] This project provides an overview about the cost-effective implementation in farming. Commercial Ubiquitous vertical is the upcoming technology that grows plants through an inert media instead of natural soil. This system has no adverse effects on environment or quality on crops. In contrast, it provides better nutrient value and allows controlling the nutrients via nutrient solution. Its main aim is to save water, improve quality of crops avoiding the adverse effects of pesticides and factors affecting quality of soil and save land. This project provides an overview about the cost-effective implementation of Ubiquitous vertical for small farmers in India. For a healthy crop growth, an optimal environmental condition is needed. The environmental condition information is very important to control the most appropriate devices. [14] The parameters are useful to express the functionality of both devices and services. Internet of things acts as the bridge between the physical objects such as place, person, or device which is known as “things”. IOT consist of set of heterogeneous set of devices which are uniformly discoverable, closely integrated with the Internet infrastructure and service, regardless of the devices (RFID, sensor, or embedded devices).

General structure of a vertical farm



III. AN OWL-BASED ONTOLOGY FOR INTELLIGENT SYSTEM

Ontology is a widely accepted tool for the information in pervasive computing and also considered to be advantages over the other modelling techniques. The OWL is part of the growing stack of W3C recommendation related to the semantic web. [1] As semantic web is considered to be the future of web, OWL based ontology is widely used in the applications. Many researchers have been undergone in the vertical farm context modelling based on the OWL Ontology explains the situation categorization and its services relationship through OWL based on RDF. As it is in the beginning stage, many such research and development are expected in modelling of context. Vertical farm ontology (VFO) is designed focusing on the service based vertical farm without any human intervention. [2] The ontology model is designed using OWL based on RDF and implemented in this project. In this fast-evolving world of technologies, the model needs to be developed considering the future evolution. In our paper, we built a domain-specific model which is extensible.[3] The first step handled in designing the model is by identifying the concepts of the environment. [4] The

concepts are physical or conceptual objects in the domain.

The concepts are context, devices, service, environment, network, location, and user. In the next subsections, each of the concepts is distinctly presented and explained [16].

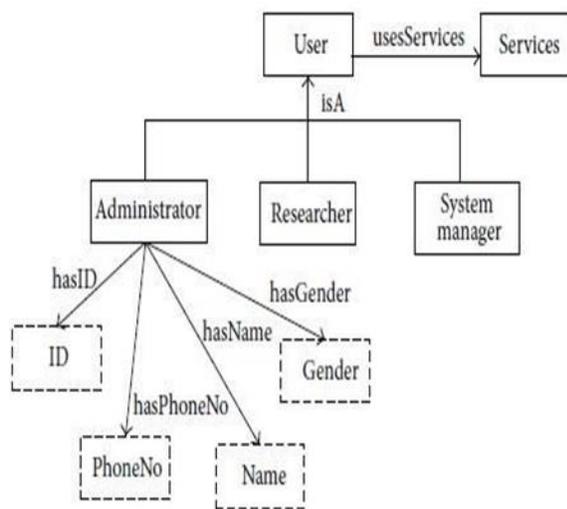
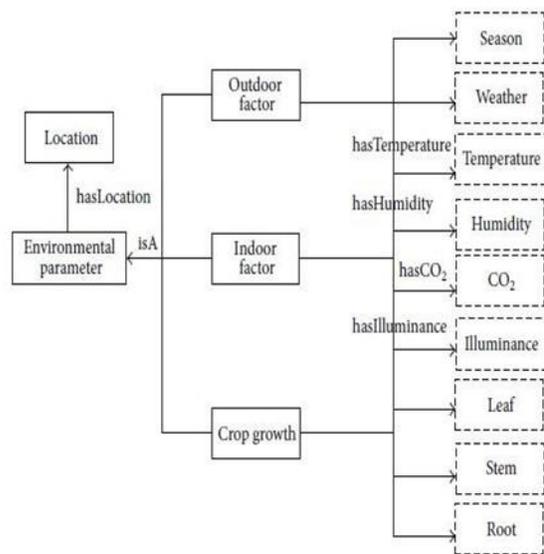


Figure: Basic User Concept

Vertical farm environment is entirely automated environment with intelligent services such as monitoring and controlling services. The user concept makes use of such smart services. The context information obtained from time to time are monitored by the User.

A. *Environmental Parameter Concept Presently*, IOT is considered as the ideal emerging technology to influence the domain by providing new evolving data and the required computational resources for creating revolutionary apps. In VFO, the autonomous services are achieved through the sensors and actuators. [18] Sensors are directly related to the environmental parameter, from which the values are sent to the server via Wireless communication protocol (Zigbee). The actuators are indirectly linked to the parameter. Actuator controls the control equipment such as air conditioner, heater, window, humidifier, and light. The result in the variation of environmental parameter affects the actuator to maintain the optimal condition through controlling the

equipment. As we mention environmental parameter, it includes both the indoor and outdoor environmental conditions. Although the indoor factor plays major role, the outdoor factors are not to be omitted. According to the daily weather condition, the environment parameter needs to be manipulated and processed.[12] Factors such as season, daily weather, and day-night atmospheric differences are also taken into account for the more appropriate growth condition. As for the indoor parameter, the atmospheric condition and the soil condition (can also referred as soil nutrient) are given major concern.



B. *Location Concept*

The main concept of vertical farm is to produce maximum amount of crop production with optimal condition, even in the middle of the urban area.[13] Hence the skyscrapers have much number of floors with variety of crops in it. As each crop is distinct, each needs a different environmental condition. Therefore, keeping a track of the crop and its location is much more important. Figure shows the overlook of location concept.

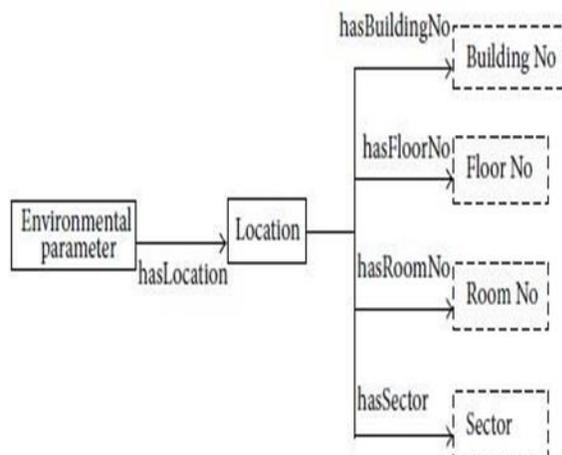


Figure: Location Concept

CONCLUSION

The area of machine learning has acquired a sustainable growth, because of the accuracy it offered in the different fields of application. Agriculture is one of the fields of application ML. The agriculture is a segment which confronts various challenges every day and hence prevent to be the most discouraging business into days' time. In this section, we present the implemented part of our VFO model. According to Hendrickson and Indulska, efficient use of context model needs careful planning; therefore, careful planning was done before the implementation. In our model, we have domain named class context where all the context information is gathered. In vertical farm environment, the set of environmental parameters and the location of the particular factor is considered to be more important. Figure 6 shows the high-level context information and the relationship of the particular scenario.

POSSIBLE OUTCOME AND FUTURE WORKS

The possible outcome of our developed prototype is as follows:

- Weather monitoring.
- Water Ph monitoring.
- Water monitoring.
- Machine learning algorithms will provide better accuracy to grow the plant in specific condition.

The overall system is developed for monitoring specifically the three parameters. The system works perfectly, transmit information on the server and mobile app very efficiently in real time.

However, a number of ubiquitous sensors for monitoring and analysis of other parameters like, soil PH value etc. can also be used. In the future work, an algorithm for artificial intelligence-based application for new application module will be developed.

SENSE OF CONCERN

The authors declare that there is no sense of concern and conflict regarding the publication of this paper.

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