An analysis of the network of rural producers in the state of Rio de Janeiro

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Abstract. The unexpected growth of the world population and the exodus from rural areas to the city lead to a food insecurity concern. Also, a strike of truck drivers caused significant impacts on the distribution of food in the city of Rio de Janeiro and other cities in the country. The unexpected growth of the population and the strike of truck drivers incident are examples of food insecurity in many cities in the country. To address the food insecurity problem, solutions guided by the Internet of Things paradigm such as smart farms have been gaining increasing attention. However, food production in smart farms is still a challenge. To surpass this challenge, a possible solution is to map the information regarding the producers of the state of Rio de Janeiro, and analyze this data together with other sources, reducing the difficulties in the distribution of food products, and allowing information exchange, for the development of sustainable cultivation. In this paper, a small analysis of the producers of the state of Rio de Janeiro is presented. We then present an initial monitoring system that would allow a big data analysis in the future. These analyzes are implemented based on environmental data (temperature, humidity, light intensity) that are related to the growth of these producers' crops.

Keywords: smart farm, vertical farm, Internet of Things, social IoT

1 Introduction

According to studies by the Food and Agriculture Organization of the United Nations (FAO), 18.7% of the world's population or 1 billion people are suffering from food insecurity. Food insecurity refers to the limitation or even uncertainty regarding adequate nutritional availability for people [3]. There is a perception that there is enough food production in the world and that the real problem is

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with the distribution of such production [1]. Recently, we can verify in Brazil that a strike of truck drivers caused a real problem of food distribution, causing significant impacts on the distribution in all the major Brazilian cities. However, regardless of food distribution, there is still a challenge respective to food production. The demographic growth and urbanization are closely associated with the food production challenge of the 21st century, as it is not possible to increase food production at the expense of expanding the agricultural area [3]. It is necessary to develop tools that help generating sustainable agriculture with the limited agricultural areas we have available.

According to [16], when addressing the subject of agriculture in urban areas, it is common the immediate reference to community gardens. This fact occurs because the word "garden" is understood as synonymous with cultivating vegetables in flower beds. In the city of Rio de Janeiro (within the state of same name, Rio de Janeiro), the domestic yards represent real strongholds for the practice of food production. To demonstrate the importance of family farming in the state of Rio de Janeiro, we present an initial application of a monitoring system that would allow a big data analysis in the future, using data from a network composed of three producers from the city of Duque de Caxias in the State of Rio de Janeiro.

Another important aspect for urban agriculture is the crop's health. The health of a crop can be controlled with a new production technique called Integrated and Sustainable Agroecological Production (ISAP) [17]. The ISAP is a model of technology that improves the quality of life of rural workers, as it promotes social inclusion and income generation for the rural community. Its production techniques are based on environmental preservation, avoiding the use of products or actions that combine animal husbandry with organic production. Linking these productions to technology helps to solve the problem of sustainable cultivation, promotes water saving and monitor information related to crop growth. One of the main information for the development of the crop is respective to some climatic factors, such as: temperature, luminosity and humidity. These factors can interfere in a beneficial or malicious way in the development of the cultivation. Therefore, controlling these factors is of paramount importance. Climate monitoring systems in the context of protected cultivation are part of the Internet of Things (IoT) context. Such systems allow their services, as well as the data produced, to be accessed on the Internet.

The objective of this work is to present an initial application of a monitoring system that would allow a big data analysis in the future. These analyzes are implemented based on environmental data (temperature, humidity, lighting intensity), which are called edaphoclimatic conditions and are related to the growth of the crop.The data were collected from 3 different producers in the city of Duque de Caxias, where the prototype was implemented.

The remainder of this paper is organized as follows: Section II presents the related works. Section III presents our proposal. Section IV presents conclusions and future works.

2 Related Work

Recent years witnessed the increasing of IoT application deployments in smart cities [14][10][15], such as smart agriculture. In [15], the authors identified potential applications of IoT in agriculture for sustainable rural development. It has shown the business benefits that can be derived from IoT by various domains of agriculture. These domains include water management, weather forecasting, wildlife management, finance, forestry, plant and animal disease management, transport and storage of agricultural produce, extension services, etc. The study is meant to influence policy on the adoption of IoT in rural development and agriculture.

In [18], the authors propose an agriculture framework which will give connection to any appliances through a web browser. Their system used agricultural appliances, such as: pH meter, street light, water motor and sprinkler. In environment, these devices were connected to raspberry PI devices, in which the configuration file is stored. A farmer can turn on a motor when he wants, through the web server connected to the IoT framework. For street lights, the system senses the darkness and turns them on automatically. Whenever a crop needs water, the farmer can turn on a sprinkler from any place through the web browser. To check the moisture of the soil, the farmer can use a pH meter using IoT. The above process helps the farmers in performing smart farming activities.

In [19], a complete IoT solution for plants was designed. The solution ranges from bottom hardware to terminal application, and massive data are obtained by the system. A hadoop-based solution is also provided for big data analysis applications. The analyzes are implemented on the basis of environmental data (temperature, humidity, illumination intensity and air) that is related to plant growing. Based on the analysis' results, guidance of plant cultivation is given to user. The implementation of this solution is valuable for establishing big data-based IoT systems.

The current research on indoor intelligent agriculture is mainly focused on three aspects: (i) Design of a system framework, in order to support the feasibility of the system while it is not implemented; (ii) Design and implementation of the farm system, which focuses on monitoring the environment of indoor crops (this kind of work achieves the deployment of system and acquires data of crops, but there is lack of analysis and utilization of these data), the future direction of our work; (iii) Group composed of plant experts always analyze the influence of specific environmental indexes on crop growing through different contrast experiments, but there is lack of corresponding technical competence for establishing specific intelligent agricultural system. Then, an integrated solution for establishing indoor or outdoor intelligent agriculture is proposed in this paper, which includes the deployment of the system indoor farm, cloud-based analysis and service, as well as a procedure of connection between farms.

3 A case in the Smart Farm paradigm

In this Section, we describe a scenario of a real Smart Farm. In indoor agricultural environment, the main sensing indexes are temperature, humidity, illumination intensity and these indexes are monitored with various sensors. Data sensing devices are connected to Mobile Communication Network or Internet via WIFI. These devices acquire data from sensors with fixed frequency, a reading every 1 minute, then pack the data and upload data to cloud platform, through the connection with the platform Thingspeak.com. Users access the cloud platform with a simple account in the platform and have the possibility of obtaining environmental data related to plants real-timely.

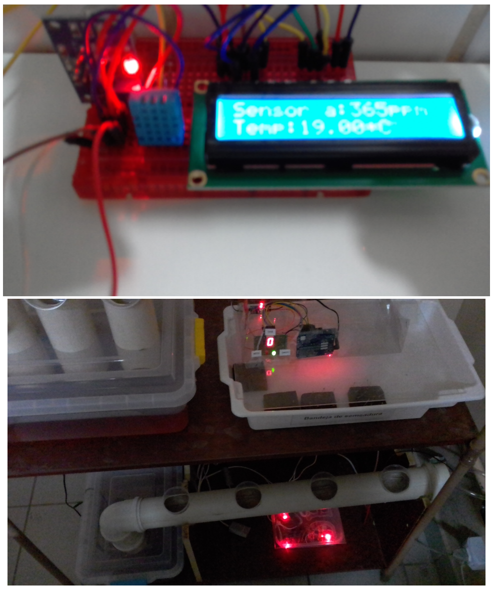

Fig. 1. Prototype and sowing system

Data sensing device is the prototype made for acquisition of indoor environmental data, the device is shown in Fig. 1. It is composed of 1 micro controller Arduino UNO, communication module (ESP8266 WIFI module) as well as various sensors to be used for detecting environmental data. Such as, DTH11. After monitoring the climatic factors, then its uploads data to cloud platform with WIFI module. Since the beginning of the project, several steps have already been developed: (i) The sowing monitoring, shown in Fig. 1; (ii) The monitoring System with persistence of cloud data, shown in Fig. 4; (iii) the Urban Agriculture, Open Environment Cultivation and Irrigation shown in Fig. 2. The Collection and the analysis of collected data are shown in Fig. 3.

Fig. 2. Urban Agriculture, Open Environment Cultivation and Irrigation

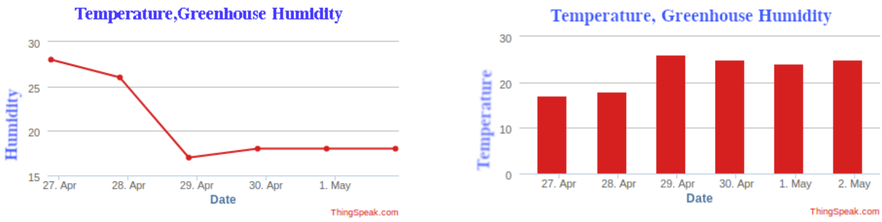

Fig. 3. Data Analysis

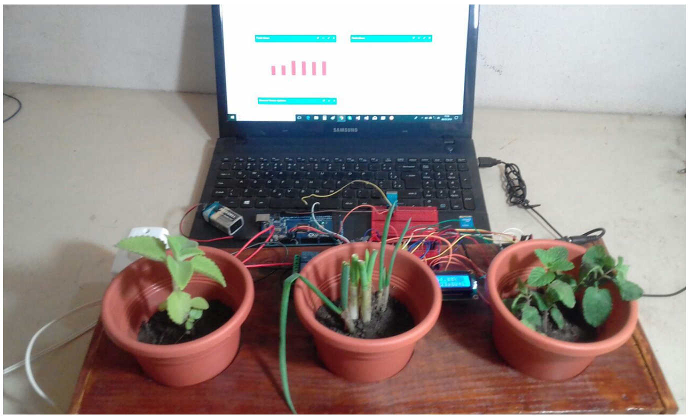

Fig. 4. Monitoring System with persistence of cloud data

4 Conclusion

In this work we presented our vision about an initial application of a monitoring system that would allow, in the future, a big data analysis. Initially, using data from a network composed of three producers from the city of Duque de Caxias in the State of Rio de Janeiro. In the future, we will discuss the data collected from the 16 producers certified as Integrated and Sustainable Agroecological Production (ISAP) in the Fluminense lowland region. The analysis of these data will consider the specific knowledge of these rural producers, allowing to exchange information about their productions,together with the parameters collected by the sensors and other existing databases, such as Embrapa, and meteorological bases.

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