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Medicinal plants and green design in smart cities

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Abstract— **Aromatic and medicinal plants can play an essential role in the green revolution at the heart of tomorrow's smart cities. This plants always the fulcrum of the relationship between man and the plant world, they represent an extraordinary resource in the search for food sources, in the fight against diseases and to improve the quality of life. The effect of green space on people's mental health is significant. It can encourage people to exercise, provide areas for socializing, reduce noise and air pollution, and improve immune function through exposure to beneficial microbes. It can also help with psychological recovery. Smart city is an application of Internet of Things (IoT) notion. Unceasing growth of population and urbanization have intensified innovative ways to handle urbanization with minimal impact on environment, citizen lifestyles, and governance. This study allowed us to identify and investigate the design of medicinal plants in smart cities, challenges and strengths in this design.**

Keywords— Medicinal plants, Internet of Things, Green spaces, Smart cities

I. INTRODUCTION

Advanced information and communication technologies (ICT) such as smart devices, mobile networks, data storage technologies, and software applications have created smart cities [1]. Aromatic plants have a particularly important role to play in creating a balanced ecosystem for the air and soil in cities. In the modern period, natural chemicals produced from medicinal plants have also played an important role in medication discovery and development [2]. Meals, spices, cosmetics, aromatherapy, and perfumes all use medicinal and aromatic plants. Phytochemicals produced from plants are increasingly being used as food preservatives, colorants, sweeteners, and other applications [3]. Out of roughly 46000 plant species worldwide, at least 28,187 have been used for medical purposes and in regulatory documentation, only 4,478 of these therapeutic plants were mentioned [4]. They also represent a precious resource to respond to the deep desire for nature that is one of the most heartfelt needs after the lockdown, especially among those living in a metropolis.

In comprehensive definition smart city is defined as an advanced modern city that utilizes ICT and other technologies to improve quality of life, competitiveness, operational efficacy of urban services, while ensuring the resource availability for present and future generations in terms of social, economic, and environmental aspects [5]. On the other hand, the conception of smart cities includes the city organization and management as a whole through technology. It is constructed and maintained by using integrated technologies, such as sensors, electronics, and networks [6].

In this study, the importance of medicinal plants in terms of design and smart/ innovative urban medicinal plants garden practices are discussed and evaluated.

A. medicinal plants in the green spaces and gardens

Many city-dwellers already grow medicinal plants individually on their own balcony, or in communal experiences such as urban gardens. But could there also be a productive dimension to city-grown medicinal plants in the context of the circular economy and with the involvement of the extraction industry?

Figure 1. The design of medicinal plants in the green spaces and gardens

The open spaces of the city are covered with trees, bushes, shrubs, flowers, grasses and other plants that are maintained or created with human supervision and

management to improve the living conditions, habitat and welfare of the people working in that place. On the other hand, medicinal plants usually cover the soil surface in a short period of time and create a special beauty due to their greenness and shortness, and they do not need a lot of food and water. Also, some of them are resistant to soil salinity and have high durability and long life and adaptability and endurance. Medicinal plants are very diverse. Therefore, considering the adaptability and ability of medicinal plants, the use of these species in the urban green spaces doubles the variety of species and ecotypes (in terms of color, form, size and compatibility) and increases the certainty factor of the success of the design and the flexibility of the design (Fig. 1).

II. SMART CITIES AND DESIGN OF MEDICINAL PLANTS SITES (MPS)

Smart city is an application of IoT notion. Unceasing growth of population and urbanization have intensified innovative ways to handle urbanization with minimal impact on environment, citizen lifestyles, and governance. In generic terms, smart city is an urban environment that utilizes information communication technology (ICT) and other related technologies to enhance performance efficiency of regular city operations and quality of services (QoS) provided to urban citizens [7]. In formal terms, experts have defined smart city considering various aspects and perspectives.

There are many aspects of smart cities where smart solution is possible like education, homes, manufacturing, transportation, farming etc. Each application area of smart city is associated with many of the sub-aspects [8], [9]. In the urban environmental or farming, areas can be considered as smart green spaces where medicinal plants are planted. These spaces can include gardens, parks, universities, roadsides, etc. The gardening components of medicinal plants are listed in Table 1.

When designing the garden, professional competence is required to solve these concerns while completing the analysis, planning, design, management, and monitoring of the natural and artificial surroundings [10].

Water management or precision irrigation is of paramount importance as fresh water resources in the world are limited and less efficient conventional irrigation methods lead to wastage of irrigation water along with change in soil properties and reduction in crop yield quality and quality. Therefore, in the smart medicinal plants garden, water, soil and plant crop management have special importance.

The process expressed by names such as Smart Agriculture and or digital green space generally refers to the integration of smart technologies including sensors, automated decision systems, information and communication technology infrastructure.

Sensors can include:

1. Irrigation time detection sensor
2. Sensor of detecting the plant's need to nutrients
3. detection sensor of the time of harvesting the plant according to the amount of essential oil and aromatic substances

Evaluation and advances in IoT have created new paradigm for environmental monitoring. IoT has provided the possible solution for expansion of current weather monitoring infrastructure [11].

After evaluating various researches and literatures for irrigation planning based on weather conditions, the weather parameters affecting the irrigation scheduling and its prediction using ML are:

· wind speed,
· wind direction,
· air temperature and
· humidity.

TABLE 1. Components of medicinal plants gardening

Sites	Activities	Smart gardening	
Public and private gardens	Medicinal plants cultivation	Soil monitoring	Weather monitoring
Parks	People	Soil temperature	Wind conditions: 1. Speed 2. Direction
Green spaces		Soil moisture	Precipitation
Road sides			Temperature air
Universities			Humidity air
Government organizations			Solar radiation

The weather conditions to be sensed by the weather station are specifically selected to aid in utilizing ML algorithms for irrigation prediction and scheduling.

The weather station developed gathers the required weather information with the help of suitable sensors. The gathered information is provided to the user via IoT. IoT enables the user to monitor field weather condition as and when required without physically visiting the farm land (Fig. 2).

The devel opted weather station is designed to be low cost, for this free IoT server has been selected for data storage and visualization.

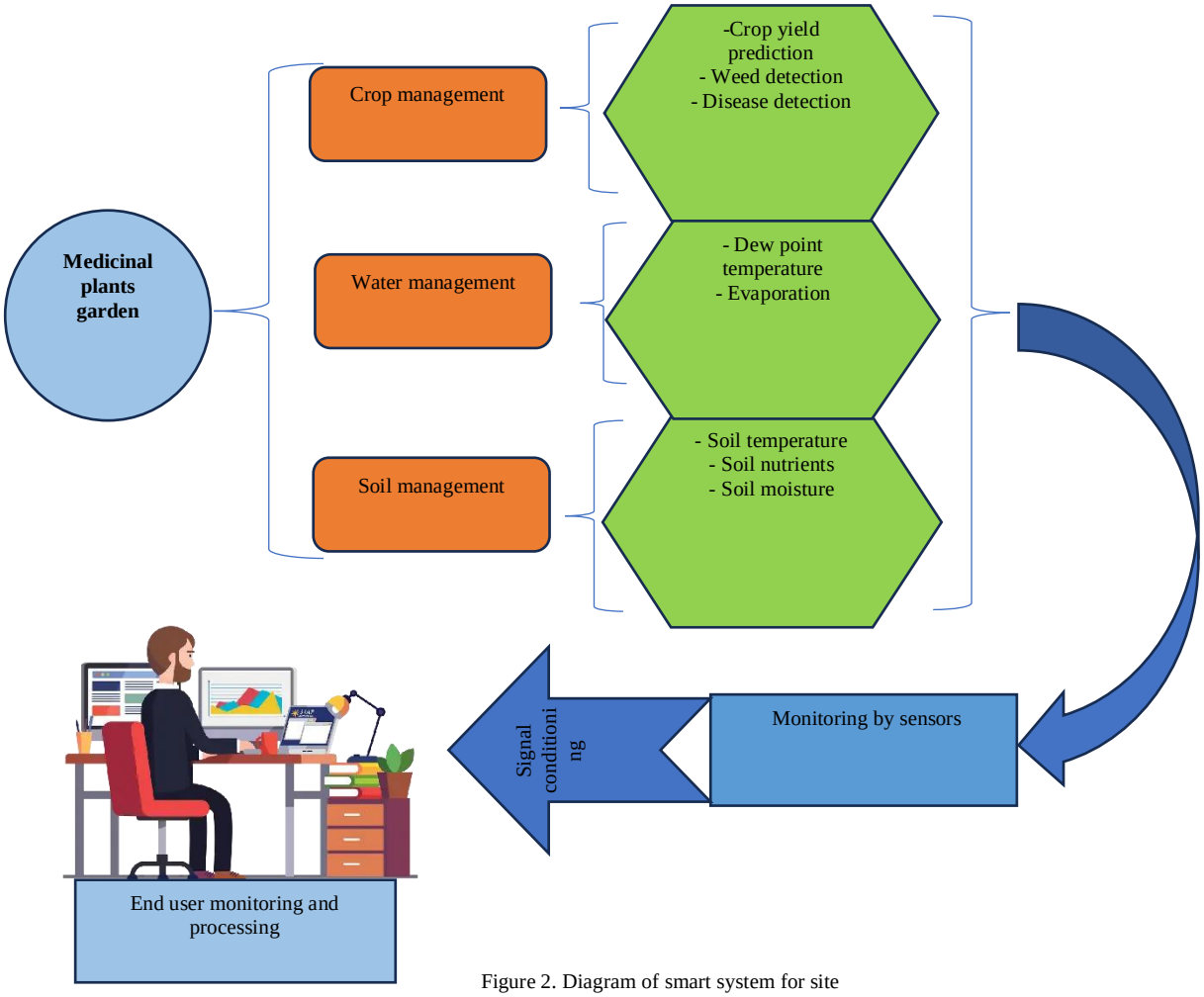

Figure 2. Diagram of smart system for site management

III. THE CHALLENGES AND OPPORTUNITIES

The challenges and opportunities related to smart management of green spaces (including medicinal plant gardens) is identified and summarized in Fig. 3.

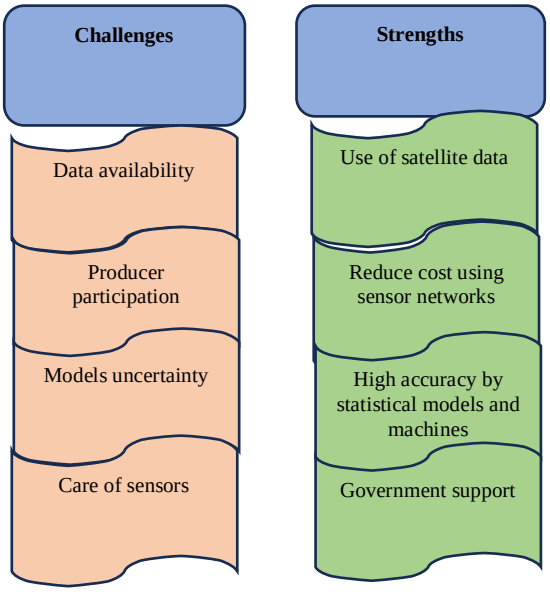

Figure 3. The challenges and strengths related to smart management

IV. CONCLUSION

The paper summarizes the various technologies for IoT, gardening applications using IoT and ML. The article also discussed the importance of soil and weather conditions in irrigation panning and environmental conditions affecting the irrigation planning the most. IoT with ML assist farmers in planning gardening activities precisely.

The purpose of this study is to discuss the interaction between new technologies, lifestyles and nature in urban areas, in the light of experiences in botanical gardens, evidence from scientific research and ideas and suggestions for companies. The companies that implement sustainable production projects focusing on these issues. Therefore, the implementation of smart green spaces can be further developed using the ideas and opinions of researchers.

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