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Cost Effective Autonomous Plant Watering Robot

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***Abstract:** This paper presents a solution to those who forget to water the indoor potted plants because of the busy schedule. It presents a system that is fully autonomous and cost-effective.*

This autonomous system consists of a mobile robot with RFID detector and a temperature-humidity sensor and uses wireless communication between the mobile robot and sensing module. Thisautonomous system is adaptive to any kind of weather condition and addresses the watering needs of the plants with the help of temperature-humidity sensor. The gardening robot used is portable and contains an RFID module, Controller, awater reservoir and a water pump. Without human intervention thisautonomousrobot can sense the watering need of a plantlocatesthe plant following a predefined path and then waters the plant.An RFID tag attached to the potted plant helps for identification. In addition this paper describes the implementation of the system in detail along with the complete circuitry. The paper is concluded with the analysis of water carrying capacity and time needed to water a set of potted plants.

***Index Terms:** Atmega16 micro controller, RFID reader, Mobile robot, RFID Tag, motor drivers, DC motors.*

I. INTRODUCTION

Plants are a pleasing addition to any house or patio. At the very least, they add colour and interesting shapes to a bland room. In late 1980s, a study by NASA and Associated Landscape Contractors of America (ALCA) had concluded that the common decorative houseplants like bamboo palms, money plants, snake plants, ficusbenjamina, Chinese evergreen and spider plant purify the air we breathe by absorbing toxins and acting as little oxygen factories. Plants became an essential part of human life as theyact as stress releivers by removing mental fatigue and improving the quality of air. Unfortunately, several plants die each year due to insufficient watering and improper caring. We all have seen the brown, withered leaves about to fall off. Now a days, due to busy life routine owners either forget to take care of these precious possessions, or they just don't have time to take care about their watering needs. The watering techniques used till date are either, stagnant and not portable or they are very costly. In this case the "Plant Watering Autonomous Mobile Robot" will do the needful by providing a cost-effective solution to this problem. Moreover today, labour and security are the largest factors. Over 30% of the production costs are expendedfor employees towards wages. This fact is responsible for starting the research on automation of the most repetitive and tedious tasks involved in horticultural activities and also crop production many years ago.Moreover, one of the major concerns in India is security. Especially in metropolitan cities people usually do not let the workers enter the house in their absence. This system will act as the personal gardener and is a boon for those who love to growindoor potted plants but cannot manage due to the busy life schedule.

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II. PROPOSED DESIGN & PRINCIPLE OF OPERATION

The Autonomous watering system can be used in any field with the plants kept in aline along the predefined path that will be followed by the robot. An RFID tag is attached to each plant. The plant has to be within 4 inches of the autonomous robot as the range of the RFID EM-18 Reader Module is approximately 4 inches and the RFID tag has to face the RFID Reader Module. As the system carries limited amount of water in one go the size and the number of pots to be watered would be restricted. 12V DC power is supplied to the water pump, and gets triggered using a 6V relay. Voltage is supplied to the relay to get toggled instead of physically touching the relay to switch that on/off. To allow the water to get dispensed easily, the height of the plant should be chosen in accordance with the height of the robot.

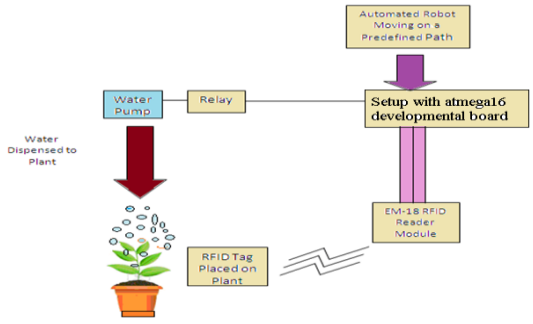

Fig 1. Architecture of the plant watering robot

The Plant Watering Autonomous Mobile Robot will follow a predetermined path that will bring it in close proximity to plants. Using an RFID (Radio Frequency Identification)-tag on it, it will detect the nearby potted plant placed within 4 inches. The tag is detected by the RFID reader module EM-18 placed on the mobile robot. The plants are placed along the path the autonomous robot will follow. An electrical water pump that gets triggered by a small relay releases water from the on-board water reservoir to the plant.

Once the robot waters all the plants it returns back to a specified point at the end of the path.If the water in the reservoir gets exhausted robotstops examining the plants and returns back for refilling the water reservoir manually. At first the mobile robot starts moving in the forward path as per given predefined path.RFID Reader is attached with the robot and the robot moves continuously till it come across any potted plant.

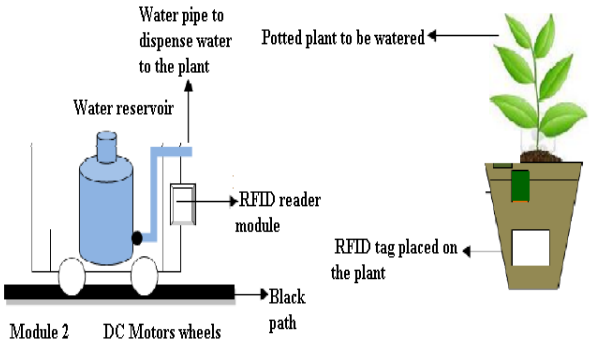

Fig 2: Overview of the plant watering robot

On the other side a setup with potted plant and RFID Tag is attached to that plant is ensured. If the mobile robot with EM-18 reader come across RFID Tag placed on the plant, then rfid reader detects the value of the rfid tag and reads the value and identifies it with given value in the program.

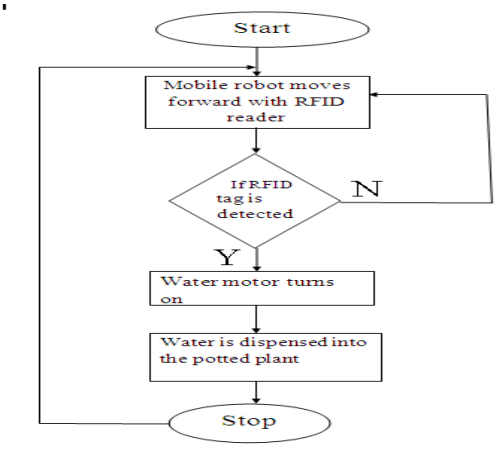

Fig 3. Flow Chart of Plant Watering Robot

If the given value and detected value is matched then water pump motor turns on, and dispenses water to the plant. After watering the plant mobile robot stops for same time and again follow the same process shown in figure 3.If the tag is not detected the mobile robot continues to move in the predefined path till it come across any potted plant. It will follows the path for some time period given and in that time period if it is unable to detect any plant it will stops.

III. RESULTS & DISCUSSIONS

The Plant Watering Autonomous Mobile Robot is well designed taking all the shortcomings of the existing systems into consideration. On comparison with the existing systems for watering the indoors plants as discussed in the introduction section, our system design emerged out to be efficient in terms of portability when compared with the 'A Smart System for Garden Watering using Wireless Sensor Networks', as the above mentioned system is stagnant and valves are attached for watering the plants which lay all around the plants spoiling their natural beauty, User ease and maintainability were the areas where our design proved to be better when compared with the system ''Pot Pet: Pet-like Flowerpot Robot' as the Pot Pet system doesn't actually water the plants, it just alarms the user to water the plants manually. The system is also not easily maintainable as the plants when large in number roaming here and there are difficult to manage unlike the design proposed in this paper where there is just one completely autonomous robot, following a predefined path without disturbing the people nearby.And finally it has an edge in terms of cost effectiveness when compared with the 'A RoboticPlant Care System' by Intel.

IV. CONCLUSION

In this paper, we presented an autonomous plant watering system which helps watering indoor potted plants that are arranged along a predefined path. The mobile robot is capable of detecting the RFID tag of the plants that need water, locating those plants and finally watering them autonomously. The system is equipped with an autonomous vehicle, an Atmega16 microcontroller, an RFID module, a water pump and a relay. The performance of the individual components has been assessed in the laboratory by various experiments. The number of pots that are watered, time taken by the system to water the selected set of pots and the water required in millilitres have been depicted. The graph between the time required by the autonomous robot to carry the watering operation and the number of plants watered indicates that this autonomous system is cost-effective and efficient.

V. FUTURE SCOPE

In future, solar panels along with rechargeable batteries may be used instead of 9V batteries to make this system reliable, efficient, and self-sustainablewith respect to energy consumption. And we also plan to enhance the system's ability in order to be managed remotely. This can be achieved by accessing and controling the system with the use of web-services (e.g. via Android smart-phones). A wireless Web Camera can be used instead of RFID tag to identify the plants. This reduces the cost of the system considerably. Furthermore, the same can be used for path planning and obstacle avoidance for the mobile robot.

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