Increased Automation

Problem Statement 1 - Cleansing

Background of Current Process & Challenge Statement

Cleansing is a crucial component of routine park operation. Chores like cleaning of footpaths, jet washing and leaf blowing often requires several workers and can be very time consuming. Lakeside Garden along with both Chinese Garden and Japanese Garden will form a large parcel of land and this will be taxing for the cleansing contractor to manage the Gardens. For better allocation of manpower and also a more efficient cleansing routine, it will be beneficial if autonomous robots, which are able to perform the abovementioned cleansing duties, can be deployed within the garden.

Desired Outcome

The robots should be able to perform the following:

Identification of waste through data analytics

Clearing of waste and compacting the waste to increase storage space within the robot

Execute jet washing works along stretches of footpath without causing disruption to the public

Able to carry out leaf blowing duties without causing disturbance to the surrounding

Identification of various leaf shapes through data analytics

Able to function properly on stretches of footpaths of different materials (cobblestone, asphalt etc)

Sensors to be installed for detection of approaching objects (cyclists, park visitors, animals)

Requirements

Outdoor friendly, water and weather proof, able to adapt well to various terrains, easy to charge, able to be safe for deployment without causing disturbance to public

Background of Current Process & Challenge Statement

Cleansing is a crucial component of routine park operation and in view of the current Covid situation, constant cleaning of garden facilities is required. Facilities such as playground equipment, benches and counters have surfaces that are in constant contact with visitors and require manual disinfection. To reduce heavy reliance and better management of manpower, an autonomous robot which is able to provide outdoor cleansing will be beneficial for JLG.

Desired Outcome

The robot needs to be able to perform the following:

Cleansing of outdoor facilities using methods like UV rays or spraying of disinfectant

Able to be programmed to carry out a cleansing routine and provide cleanliness updates of the area

Ability to update Park managers on cleansing

Charging using renewable energy like use of solar panels will be good

Requirements

Outdoor friendly, weather proof, light and transportable, able to adapt well to various terrains, fast charging, certified safe for deployment in public spaces

Background of Current Process & Challenge Statement

There are many swales within Lakeside Garden that drain surface runoff and convey stormwater to Jurong Lake. Maintenance of the swales is a challenge due to their sloping nature, and there are often weeds growing along swale channels which reduce drainage efficiency. To maintain it, workers are required to manually perform weeding and constantly replace rocks that slide downwards after a heavy rain.

To ensure constant efficiency of the swale drainage, use of technologies can be explored to carry out clearance of weeds and to reduce the need for intensive manpower.

Desired Outcome

The robot is able to be conduct maintenance works by doing weeding and if possible, help to clear any possible blockage (rubbish etc). The waste collected will then be cleared by the contractor at a single point.
Easier charging methods can also be studied.

Requirements

Easy to maintain, weather proof, mobile, light and transportable, able to adapt well to various terrains

Problem Statement 4 – Greenery Maintenance

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Background of Current Process & Challenge Statement

The two event lawns within Lakeside Garden are popular areas that are highly utilised for major events like festivals, performances or concerts. However, despite having subsoil pipes installed below ground, water ponding/accumulation is often observed after heavy rain, which result in an unpleasant experience for park visitors using the lawns. A autonomous robot which is capable of sensing soil compaction and reduction in permeability and can also perform auto hollow tining operations to enhance drainage will be beneficial to the operation of the lawns.

Desired Outcome

The robot should be able to perform the following:

Able to drain water collected within the lawns and depressions efficiently

Lightweight to avoid damaging the turf

Able to identify puddles of water to drain

Able to travel on soggy terrains without getting stuck

Capable of performing auto hollow tining operations which will enhance drainage

Requirements

Outdoor and user friendly, water and weather proof, able to adapt well to various terrains, easy to charge, able to be safe for deployment without causing disturbance to public

Problem Statement 5 - Greenery Maintenance

Background of Current Process & Challenge Statement

Shrub pruning is a labour intensive process which takes up a large proportion of horticultural maintenance. During the circuit breaker in 2020, the lockdown of workers resulted in the inability to carry out shrub maintenance works. An automated robot which can help with the pruning of shrubs will be beneficial for the operation of the gardens.

Desired Outcome

The robot would perform the following tasks:

Be able to prune and maintain shrubs to various heights and sizes according to pre-programmed instructions

User friendly for users to change the settings on a panel or on a back end system and change pruning patterns and methods for different shrubs

Requirements

Easy to maintain, mobile, weather proof, light and transportable

Problem Statement 6 – Cleansing

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Background of Current Process & Challenge Statement

Situated right beside the Jurong Lake, the shorelines of Jurong Lake Gardens are often littered with rubbish washed up after a heavy rain. Shoreline cleansing is a challenge for the cleansing contractor as it is labour intensive and the work terrain is often unpleasant. It will be beneficial if a robot is able to perform shoreline cleansing and reduce the manpower required.

Desired Outcome

The robot should be able to perform the following:

Perform effective clearance of waste along the shoreline

Able to identify waste through data analytics

Requirements

Outdoor friendly, water and weather proof, light and transportable, able to adapt well to various terrains, easy to charge

Problem Statement 7 – Greenery Maintenance

Background of Current Process & Challenge Statement

The weeding of green areas is a labour intensive process. Weeds sprout quickly and require constant removal to avoid subsequent weed infestations. An automated robot which can help with weeding will be beneficial for the operation of the gardens.

Desired Outcome

The robot would perform the following tasks:

Be able to identify weeds and avoid injuring the surrounding plants.

User friendly for users to change the zones from a back end system

Solar powered if possible.

Requirements

Easy to maintain, mobile, weather proof, light and transportable, able to adapt well to various terrains

Problem Statement 8 - **Cleansing**

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Background of Current Process & Challenge Statement

The nursery in Lakeside Garden is currently being developed. In view of the large amount of plants once development is done, it is crucial to look into sustaining the operation of the nursery. Various chores like washing of pots and garden tools tend to be very labour intensive and time consuming. To better manage the workers, it will be beneficial if such chores can be assisted with the deployment of robots.

Desired Outcome

The robot should be able to perform the following:

Assist to wash pots and garden tools

Explore the possibility of adding various functions like watering of plants or applying pesticides.

Easy for users and contractors to operate

Requirements

Outdoor and user friendly, water and weather proof, able to adapt well to various terrains, easy to charge

Background of Current Process & Challenge Statement

Planting of trees and shrubs is a key component of horticultural operations. However, planting of shrubs is often labour intensive and time consuming. Upon completion of both Chinese and Japanese Garden in 2022, the demand for constant shrub maintenance will increase and allocation of manpower will be a greater challenge. Hence, a shrub planting robot would be beneficial to assist in the planting workload of JLG and allow for better management of manpower.

Desired Outcome

The robot should be able to perform the following:

Able to plant shrubs similarly to how a regular worker is able to

Able to plant multiple shrubs with precision and adequate spacing

Reduce the time required for planting of shrubs

Requirements

Outdoor friendly, weather proof, light and transportable, able to adapt well to various terrains, easy to charge

Human-robot/system collaboration

Problem Statement 10 - Operation within attractions

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Background of Current Process & Challenge Statement

The nursery store is a crucial piece of infrastructure that supports horticultural operations. There is a need to have an automated store which includes an inventory system to keep track of supplies and equipment within the store. It is currently time consuming to organise and keep track of the large amount of items within the current storeroom.

Desired Outcome

The team will want to have an automated system within the storeroom to help produce an inventory of the tools and equipment. This includes automatic registering of materials and equipment entering and leaving the store, as well as a system to trigger alerts when supplies run low. It will also be an additional point if the system has a panel for users to update instantly for better stock taking.

Requirements

Easy to maintain, weather proof, low cost in terms of maintenance and replacement , interfaces with the Gardens' Integrated Management System

Problem Statement **11 – Operation within attractions**

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Background of Current Process & Challenge Statement

In the upcoming development of JLG Central, the Chinese Garden will be featuring a plant factory which focuses on the planting of edibles. The team would like to explore possible options to assist in the operation of the plant factory. Tasks like seed sowing and harvesting of edibles and cleansing/sterilisation of planting equipment have to be constantly carried out. To better manage the plant factory, it will be beneficial if such chores can be assisted with the deployment of robots.

Desired Outcome

The robot should be able to perform the following:

Assist to do seed sowing and harvesting of plants

Able to scale up the shelves to access the plants

Assist to clean/sterilise planting equipment effectively within a short period of time

Easy for users and contractors to operate

Requirements

User friendly, able to access the multiple levels of shelves, easy to charge

Problem Statement 12 – **Environment monitoring**

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Background of Current Process & Challenge Statement

The Japanese Garden will be featuring a Vivarium Gallery where several aqua scaping tanks will be present. To sustain the operation of the Vivarium Gallery, constant monitoring of water parameters for the tanks is essential. These water parameters will consist of the pH, nitrate and hardness of water and is important for the survival of the fishes within the tanks. It will be beneficial if there can be a system in place which is able to digitally and constantly monitor the water parameters. The data collected can then be relayed to the user for their information and follow up actions.

Desired Outcome

The system should be able to perform the following:

Conduct water monitoring and identify the water parameters accurately

Able to notify users via a platform

Provide recommendation for follow up actions

Requirements

User friendly, portable, able to blend with the aesthetic of the tanks

Integration of deep tech (AI, video imaging)

Problem Statement **13** Environment monitoring

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Background of Current Process & Challenge Statement

The Grasslands at JLGW is an iconic area and a favourite place for photographers and garden visitors. However, it has always been a challenge for the operation team to manage it due to the lack of manpower and the vastness of the grassland. As such, having a better monitoring system in the form of aerial cameras to identify weed infested areas and bare areas requiring plant replacement will be beneficial for the team to be able to better allocate their manpower.

In addition, utilisation of technologies can also be explored for better and more efficient maintenance of the grassland in view of reducing the manpower required and improving site awareness.

Desired Outcome

The monitoring system should be able to provide a map of the entire grassland indicating multiple zones for monitoring. Through a panel showing the zones, the users will be able to have a clear view of the status of the grassland and be able to allocate their manpower to areas which require immediate maintenance.

The system will be able to help maintain the plants (weeding etc) within the grassland without damaging the other plants. Other chores like watering or fertilising are also good functions that can be further explored.

For ease of usage, use of solar panels for charging of robots can be an added bonus.

Requirements

Easy to maintain, weather proof, cabling connections to be only around the perimeter of the grassland, mobile, light and transportable, able to adapt well to various terrains

Background of Current Process & Challenge Statement

Forest Ramble is a prominent attraction amongst families with children. The biophilic playground is designed using natural wood materials and due to its high usage, weekly checks are necessary for safety purposes. The checks are conducted visually by the NParks officer together with the contractor weekly and are often time consuming.

It will be beneficial if routine playground equipment through automated systems like sensors or robots can be implemented to detect defects like damages to equipment through image or video analytics.

Desired Outcome

The automated system may come in the form of a sensor or robot. The functions of the system will include:

Detection of defects (cracks, loose screws, slanted play equipment) through digital analytics

User friendly in terms of mapping for robot paths

Ease of charging of robots will be good to explore

Requirements

Easy to maintain, weather proof, mobile, light and transportable, children friendly, able to adapt well to various terrains (sand based terrain or slopes)

Problem Statement **15 – Site monitoring**

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Background of Current Process & Challenge Statement

Constant monitoring of construction sites is a crucial part of project management. However, the use of CCTVs has its limitations due to multiple blind spots and its inability to be mobile. In additional, supervision on site is also limited due to the lack of manpower which may also contribute to work safety.

It will be beneficial if the use of robots can be deployed to survey the site and to monitor progress. In addition, Resident Engineers (RE) and Resident Technical Officers (RTO) can run through the captured videos and go through a checklist for safety and work progress purposes.

Desired Outcome

The robot to be deployed will be able to be easily controlled to survey a certain work progress and have data analytics to ensure the safety aspects (wearing of PPEs etc) are adhere to by the workers on site. The robot may also come with a user friendly back-end monitoring system where the REs and RTOs can run through and update the consultants if the progress of works is delayed.

Requirements

Easy to maintain, weather proof, light and transportable, able to adapt well to various terrains, able to detect incoming vehicles and adjust its position, data analytics function

Geo-sensing/ Monitoring systems

Background of Current Process & Challenge Statement

The use of swales helps to channel stormwater and surface runoff collected into Jurong Lake. However, it is important for the water parameters of the water channelled to be safe before it enters Jurong Lake. Hence, it will be beneficial if a mobile robot can assist in providing instant analysis of the water parameters before it reaches the Jurong Lake.

Desired Outcome

The robot should be able to perform the following:

Provide instant water parameter analysis and inform user of any parameters which are exceptionally high

Requirements

Outdoor friendly, weather proof, light and transportable, able to adapt well to various terrains

Problem Statement **17** Environment Monitoring

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Background of Current Process & Challenge Statement

As part of park development works, there is a need to have a better understanding on the soil profile through sensors to identify if the soil is adequate for planting and conduct soil analytics directly on site. Good drainage and appropriate soil type are essential considerations for planting establishment.

The ability to identify potential soil-related incidents (soil upheaval, soil failure etc) is also beneficial for development projects near water bodies or coastal areas. When abnormal soil movements are detected, contractors can be notified immediately for rectification action.

Desired Outcome

The soil profile system should be designed to perform the following functions:

Obtain soil samples and analyse the soil for adequacy for planting and drainage directly on site

Monitor soil profile and provide updates to user instantly when detecting any abnormality with the soil underground

Requirements

Easy to maintain, weather proof, light and transportable, able to adapt well to various terrains