Operational Concept Description

for the

KNEAD Example System

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DOCUMENT CHANGE HISTORY

The following table is a simple list of released revisions sent for review. Records of reviews and the review artifacts are saved with reviewer information in the The KNEAD Projectartifact repository.

Change Record

Date	Version	Author(s)	Change Reference
03 Jan 2024	P1	Lewis Collier	Preliminary DRAFT version

Each subsequent "section" outlines changes in each release.

Items in this version that are marked with change bars have been modified from the most recent previous version (e.g. P3 changes from P2) or are new as of the current revision. A list of all changed items may be found in the Index section under the heading "All Changes This Version".

Draft P1 Preliminary version of this document.

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CHAPTER 1

Scope

This document provides the Operational Concept Description (OCD) for the Garden Control System. The system will be referred to as the GCS.

1.1 Identification

The Garden Control System described in this document shall be known as GCS version 1. However, the Operational Concept Description OCD described herein shall be applicable to pre-releases such as Beta-releases for a phased release as listed for each requirement. The major system interfaces and capabilities are fully specified in Chapter 3.

1.2 System Overview

The Garden Control System will be able to measure moisture levels and control irrigation in raised garden beds. The purpose for GCS is to maintain ideal gardening and growth conditions for fruits, vegetables, and other garden plants throughout a growing season. The goal for GCS is to automate the watering process for DIY gardeners. GCS will monitor temperature, moisture levels, and additionaly environmental factors to determine when to water the plants. Garden Control System is being developed by Zachary Steinberg and sponsored by University of Maryland Graduate Engineering. The operator and maintaner of GCS will also be Zachary Steinberg. The GCS will be operated outside along raised garden beds. GCS is designed to be used by home gardeners. It is not intended for industry. GCS will be controlled by a Raspberry Pi Pico W microcontroller board.

Figure 1 shows the development kit used for the GCS system. This is an image of different versions of the Raspberry Pi Pico microcontroller board. (This is a test image)

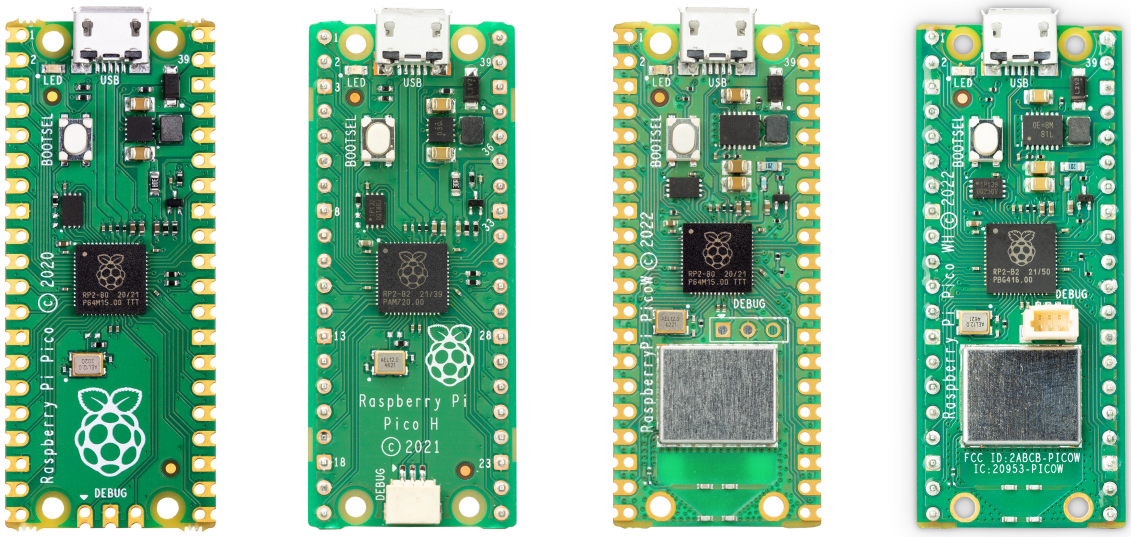

Figure 1: Raspberry Pi Pico W microcontroller board

1.3 Document Overview

This section provides information about this document's security/privacy considerations, contents, structure, and version information.

This document format is based upon the guidance in the OCD DID [1]. The operational concept is documented following the guidelines of ISO-12207 [2] and MIL-STD-498 [3] (from which ISO-12207 originated). This document follows the listed OCD sub-section order.

Section 1 provides an overview of the system and this document.

Section 2 lists general and application-specific reference documents as well as glossary terms and acronyms.

Section 3 summarizes the current status into which this system is to be situated.

Section 4 justifies why change is needed.

Section 5 describes the concept for a new or modified system.

Section 6 illustrates operational scenarios for the new or modified system.

Section 7 discusses a summary of impacts for the new system.

Section 8 details analysis of the proposed system.

Appendices if needed, provide additional information as may be needed.

If this text is visible, the first instance of each section may display a summary of data item description (DID) information shown in this font. These are displayed in small capital font and are not part of the formal document.

CHAPTER 2

References

This section provides a list of referenced items for this document.

2.1 Acronyms and Abbreviations

This section defines acronyms and abbreviations used in this and related documents.

Table 1: Acronym Definitions

Acronym	Definition
GCS	Garden Control System
UMD	University of Maryland
MAGE	Maryland Applied Graduate Engineering
ENPM	Engineering Professional Masters
End of acronym definition table	

2.2 Glossary and Definitions

This section defines glossary terms used in this and related documents.

Table 2: Glossary Terms and Definitions

Glossary Term	Definition
Communications	Communication is information transfer, among users or processes, according to agreed conventions.
Customer	The local government project lead who is acting as a general manager for the sponsor to ensure that the contractor team executes the project according to stakeholder goals.
End of glossary terms table	

2.3 Referenced Documents

This section lists the referenced documents for this document. The references are categorized into two categories:

External Documents not directly associated with this project.

Project Documents that are directly associated with this project.

2.3.1 External Documents

[1] DI-IPSC-81430. *Data Item Description for Operational Concept Description (OCD)*. Dec. 31, 1994.

[2] IEEE and EIA. *Software life cycle processes*. Mar. 1998.

[3] MIL-STD-498. *Military Standard Software Development and Documentation*. Dec. 31, 1994.

2.3.2 Project Specific Documents

CHAPTER 3

Current system or situation

This chapter will describe the need for the Garden Control System and provide context for the problem it is aiming to solve.

3.1 Background, objectives, and scope

Growing fruits and vegetables with consistent quality throughout the growing season is challenging for the average gardener. It requires consistent care and nurture for a garden's plants. Plants need consistent conditions to grow and bear their best fruit. This proves a challenge for many gardeners. Weather and temperature changes can rapidly change soil conditions. Additionally, gardners are not able to constantly be by their gardens. The Garden Control System aims to provide gardeners with a system to aid in the monitoring of their gardens and to help maintain optimal growing conditions for their plants.

3.2 Operational policies and constraints

Gardeners are constrained by their availabilty and time. Maintaining a garden is a lot of work. If a gardener is on vacation or unable to tend to their garden, garden health may be compromised.

3.3 Description of current system or situation

There is no current system that the Garden Control System is trying to improve. The garden that this system will be designed to work in is a raised garden bed in a residential yard. The garden is 8' x 4' and contains 32 cubic feet of soil. The current process of caring for the garden involves following a set watering schedule and adjusting the schedule based on weather conditions. There are no sprinkler systems set up in the garden. All watering is currently done manually and by a hose. The current situation depends on a gardener being available during set watering times. Additionally, there is no way to monitor soil health other than by visual cues. There is also no way to track the amount of water used during each watering session.

3.4 Users or involved personnel

The current system relies on gardeners to manually water their gardens. Gardeners must stay up to date with their gardening schedules and monitor garden health on their own.

3.5 Support concept

There is no support for the current system.

CHAPTER 4

Justification for and nature of changes

This chapter will detail why gardeners need the Garden Control System and how it will improve the overall quality of residential garden beds.

4.1 Justification for change

Gardens need constant care during the growing season. Any extended travel or long term time away from a garden can be detrimental from the garden's plants' health. Additionally, extreme weather brings more challenges for maintaining garden health. Extreme heat or long periods of drought can prevent plants from reaching their full growth potential. Gardeners need a system to help mitigate these risks facing their plants.

4.2 Description of needed changes

Gardeners need a system that can autonomously monitor and maintain the health of their gardens. A system needs to have the capability to monitor garden health, including soil moisture, soil pH, and other factors. The system must be able to respond to certain environmental events/thresholds (i.e. temperature, moisture levels) and activate watering systems. The system must be able to activate watering systems based on a set schedule. These changes will help solve the issues that are facing residential gardeners today.

Any additional needed changes will be added to this section in the future.

4.3 Priorities among the changes

A new smart residential gardening system will prioritize implementing a reliable watering system. The watering system will be able to be manually controlled, run on a set schedule, and respond to either preset environmental thresholds or custom thresholds that are set by the gardener.

4.4 Changes considered but not included

As of now, there are no other considered changes, this section will be updated when more is known about the project.

4.5 Assumptions and constraints

Assumptions for the Garden Control System will be added to this section when more is known about the project.

CHAPTER 5

Concept for a new or modified system

This chapter will introduce the Garden Control System and detail it's features.

5.1 Background, objectives, and scope

The objective of Garden Control System is to provide a smart gardening solution that will monitor and improve garden health for residential gardeners. The goal for GCS is to provide consistent and high quality garden care while reducing the amount of physical labor a residential gardener needs to do.

5.2 Operational policies and constraints

As of now, there are no known operational policies and constraints for the project. This section will be updated when more information is known.

5.3 Description of the new or modified system

The Garden Control System monitors and controls soil/garden health by activating the GCS irrigation system. The irrigation system will be activated based on data from GCS sensors or manually. GCS will have a button to manually activate the irrigation system and manually deactivate the irrigation system. Irrigation system will also activate by different thresholds measured by the GCS sensors.

5.4 Users/affected personnel

The Garden Control System will be operated by recreational gardeners. Gardeners will be able to spend less time maintaining their gardens and create an favorable growing environment for the garden's plants. There will be clear instructions for how to setup the system and any required materials/systems that are required for Garden Control System to operate will be clearly stated for future users. Minimal training will be required to use GCS. The Garden Control System is designed to reduce a gardener's workload.

5.5 Support concept

All users of Garden Control System will be provided with clear instructions for how to setup the Garden Control System. The instructions will include recommended configurations and layouts for how to setup GCS in a garden. Additionally, any required materials that are not included in GCS will be explicitly noted. Other support information will be added in the future.

CHAPTER 6

Operational scenarios

This chapter will detail certain operational scenarios for the Garden Control System. Use cases will be listed below and the operational scenario will be described.

6.1 Use Case: Watering Schedule

The Garden Control System will control it's watering system on a set schedule. By default, the watering system will be activated every 6 hours. The watering system will be active for 10 minutes and then shut off. This process will be able to be turned off and on. Gardeners can decide if they want to set a watering schedule. The watering system will be able to be activated manually as well.

6.2 Use Case: Manual Watering

The Garden Control System will allow gardeners to manually turn on/off the watering system. Gardeners will either toggle the system on/off.

6.3 Use Case: Environmental Watering

The Garden Control System will activate it's watering system based on different environmental factors. GCS will have sensors to monitor temperature, soil moisture, etc. Based on certain environmental thresholds, the system will toggle on/off the watering system. More information about the environmental thresholds and factors will be added to this use case later.

6.4 Use Case: Future Use Cases

OCD-6.1 :: This section shall describe one operational scenario that illustrates the role of the new or modified system, its interaction with users, its interface to other systems, and all states or modes identified for the system. The scenarios shall include events, actions, stimuli, information, interactions, etc., as applicable. Reference may be made to other media, such as videos, to provide part or all of this information.

Future use cases will be added later on.

CHAPTER 7

Summary of impacts

OCD-7.0 :: This chapter shall be divided into the following sections to describe the impacts of the new system or the expected modified system.

This chapter will describe the impacts of the Garden Control System.

7.1 Operational impacts

The Garden Control System will increase gardener productivity. Gardeners will have more free time to do other things rather than maintain their gardens.

7.2 Organizational impacts

There are no known organizational impacts. This section will be updated if any information changes.

7.3 Impacts during development

OCD-7.3 :: This paragraph shall describe anticipated impacts on the user, acquirer, developer, and support agency(ies) during the development effort. These impacts may include meetings/discussions regarding the new system; development or modification of databases; training; parallel operation of the new and existing systems; impacts during testing of the new system; and other activities needed to aid or monitor development.

There are no known impacts during development. This section will be updated in the future.

CHAPTER 8

Analysis of the proposed system

This chapter will analize the overall advantages, disadvantages, and limitations of Garden Control System.

8.1 Summary of advantages

The Garden Control System will have a massive impact on gardeners. Gardeners will no longer have to manually maintain their gardens. GCS is an extra garden hand and will help maintain optimal growing conditions for plants. Garden health will also improve. GCS will respond to environmental factors and keep garden conditions optimal for growing. Garden harvests will be more frequent, plentiful, and tastier. Overall quality of life will improve for the gardener and garden.

8.2 Summary of disadvantages/limitations

Plants do not all grow in the same conditions. The Garden Control System will be configured to maintain a garden in a specific climate zone. The garden may have plants that grow best in a different climate zone or have plants from multiple climate zones. The Garden Control System will not be configured to maintain a garden with plants from multiple climate zones. GCS assumes that all plants within the garden grow in similar conditions.

8.3 Alternatives and trade-offs considered

OCD-8.3 :: This paragraph shall identify and describe major alternatives considered to the system or its characteristics, the trade-offs among them, and rationale for the decisions reached.

No alternatives have been considered at this time, this section will be updated in the future.

APPENDIX

Notes

OCD-9.0 :: This section shall contain any general information that aids in understanding this document.

This section provides notes, as necessary, to document the system segmentation specification.