System Subsystem Design Description

for the

KNEAD Example System

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Prepared by:

Zachary Steinberg
Garden Control System
Washington, D.C. 20001 USA

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
24 Feb 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

ALL-1.0 ::

If applicable, each section has 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. Display of these DID information notes can be turned off for formal releases, but are displayed here for reference.

This document provides the System / Subsystem Design Description (SSDD) for the Garden Control System. The system will be referred to as the GCS.

1.1 Identification

ALL-1.1 :: The Garden Control System is an RP2040 based microcontroller board.

This paragraph shall contain a full identification of the system to which this document applies, including, as applicable, identification number(s), title(s), abbreviation(s), version number(s), and release number(s).

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

ALL-1.2 :: This paragraph shall briefly state the purpose of the system to which this document applies. It shall describe the general nature of the system; summarize the history of system development, operation, and maintenance; identify the project sponsor, acquirer, user, developer, and support agencies; identify current and planned operating sites; and list other relevant documents.

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 **??** shows the development kit used for the GCS system. This is an image of

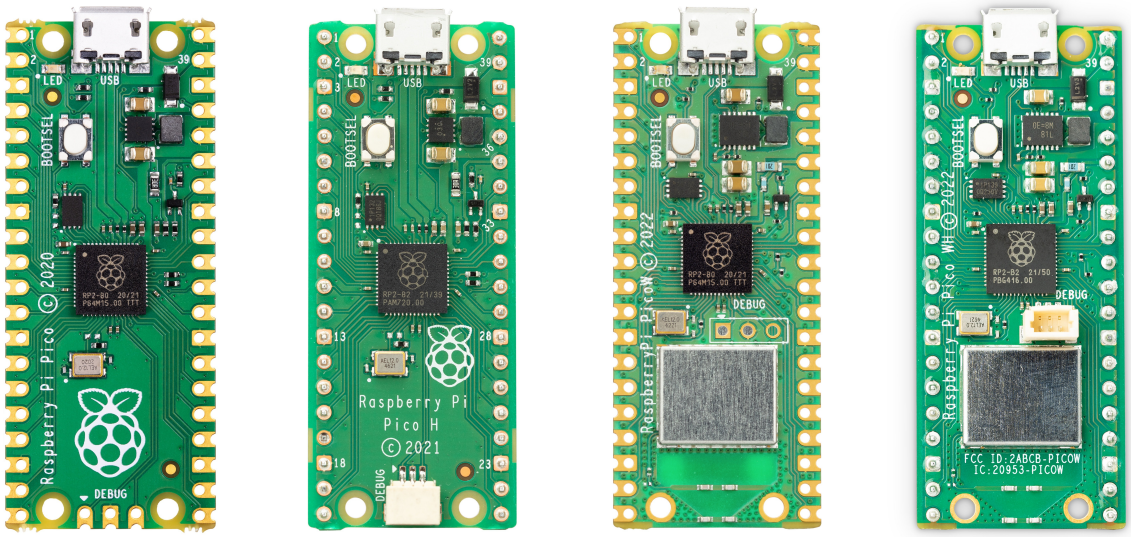

Figure 1: Raspberry Pi Pico W microcontroller board

different versions of the Raspberry Pi Pico microcontroller board. (This is a test image)

1.3 Document Overview

ALL-1.3 :: This paragraph shall summarize the purpose and contents of this document and shall describe any security or privacy considerations associated with its use.

This section provides information about this document's security/privacy considerations, contents, structure, and version information. This section also provides information regarding how specifications are formatted in this artifact and how they can best be understood.

1.3.1 Security and Privacy Considerations

This document is not subject to CUI restrictions.

This document format is based upon the guidance in the SSDD DID [**ref˙˙SSDD˙DID**]. The system design is documented following the guidelines of ISO-12207 [**ref˙˙ISO˙12207**] and MIL-STD-498 [**ref˙˙MIL˙STD˙498**] (from which ISO-12207 originated). The goal of this artifact is to provide a road map to the design implementation through either linkage to the development items (for example code, hardware, and CAD drawings) or, for larger systems, segregated documentation such as Software Design Description (SDD), Hardware Design Description (HDD), or Interface Design Description (IDD) artifacts. This document follows the listed SSDD 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 presents the system-wide design decisions.

Section 4 provides the detailed system architecture design.

Section 5 provides any applicable requirement traceability.

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

1.3.2 Document Version Information

This document was produced in LaTeX and *BibLaTeX/Biber*. The editing and document preparation were performed using MiKTeX version 2.9 with the build option [LaTeX ⇒ PS ⇒ PDF]. The LaTeX*svn-multi* package was used to glean SVN tracking information, when files are stored in an "SVN" version control system. The style `KNEADdocument` was used to provide the LaTeX and *BibLaTeX/Biber* formatting details.

This revision of this document has the following properties:

Tracking Item	Data
Repository	`https://svn.riouxsvn.com/kneadlatxinputs/ExampleArtifactFolders/5-SSDD/KNEAD_SSDD.tex`
Author	
Revision	-2
Rev Date	
Print Date	29 Apr, 2024 08:08
KNEADdocument Version	1.00
KNEADdocument Date	2021/12/05

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

2.3.2 Project Specific Documents

CHAPTER 3

System-wide Design Decisions

SSDD-3.0.0 :: System-wide design decisions. This section shall be divided into paragraphs as needed to present system-wide design decisions, that is, decisions about the system's behavioral design (how it will behave, from a user's point of view, in meeting its requirements, ignoring internal implementation) and other decisions affecting the selection and design of system components. If all such decisions are explicit in the requirements or are deferred to the design of the system components, this section shall so state. Design decisions that respond to requirements designated critical, such as those for safety, security, or privacy, shall be placed in separate subparagraphs. If a design decision depends upon system states or modes, this dependency shall be indicated. Design conventions needed to understand the design shall be presented or referenced. Examples of system-wide design decisions are the following:

- Design decisions regarding inputs the system will accept and outputs it will produce, including interfaces with other systems, configuration items, and users (4.3.x of this DID identifies topics to be considered in this description). If part or all of this information is given in Interface Design Descriptions (IDDs), they may be referenced.
- Design decisions on system behavior in response to each input or condition, including actions the system will perform, response times and other performance characteristics, description of physical systems modeled, selected equations/algorithms/ rules, and handling of unallowed inputs or conditions.
- Design decisions on how system databases/data files will appear to the user (4.3.x of this DID identifies topics to be considered in this description). If part or all of this information is given in Database Design Descriptions (DBDDs), they may be referenced.
- Selected approach to meeting safety, security, and privacy requirements.
- Design and construction choices for hardware or hardware-software systems, such as physical size, color, shape, mass, materials, and markings.
- Other system-wide design decisions made in response to requirements, such as selected approach to providing required flexibility, availability, and maintainability.

This section provides an overview of the system wide design decisions for GCS.

CHAPTER 4

System Architectural Design

SSDD-4.0.0 :: This section shall be divided into the following paragraphs to describe the system architectural design. If part or all of the design depends upon system states or modes, this dependency shall be indicated. If design information falls into more than one paragraph, it may be presented once and referenced from the other paragraphs. Design conventions needed to understand the design shall be presented or referenced. Note: For brevity, this section is written in terms of organizing a system directly into Hardware Configuration Items (HWCIs), Computer Software Configuration Items (CSCIs), and manual operations, but should be interpreted to cover organizing a system into subsystems, organizing a subsystem into HWCIs, CSCIs, and manual operations, or other variations as appropriate.

This chapter describes the system architectural design.

4.1 System Components

SSDD-4.1.0 :: This section shall

- Identify the components of the system (HWCIs, CSCIs, and manual operations). Each component shall be assigned a project-unique identifier. Note: a database may be treated as a CSCI or as part of a CSCI.
- Show the static (such as "consists of') relationship(s) of the components. Multiple relationships may be presented, depending on the selected design methodology.
- State the purpose of each component and identify the system requirements and system-wide design decisions allocated to it. (Alternatively, the allocation of requirements may be provided in 5.a).
- Identify each component's development status/type, if known (such as new development, existing component to be reused as is, existing design to be reused as is, existing design or component to be reengineered, component to be developed for reuse, component planned for Build N, etc.) For existing design or components, the description shall provide identifying information, such as name, version, documentation references, location, etc.
- For each computer system or other aggregate of computer hardware resources identified for use in the system, describe its computer hardware resources (such as processors, memory, input/output devices, auxiliary storage, and communications/network equipment). Each description shall, as applicable, identify the configuration items that will use the resource, describe the allocation of resource utilization to each CSCI that will use the resource (for example, 20resources.
- Present a specification tree for the system, that is, a diagram that identifies and shows the relationships among the planned specifications for the system components.

This section lists and describes the system components.

4.2 Concept of Execution

SSDD-4.2.0 :: This section shall describe the concept of execution among the system components. It shall include diagrams and descriptions showing the dynamic relationship of the components, that is, how they will interact during system assembly, storage, deployment, and operation, including, as applicable, flow of execution control, data flow, dynamically controlled sequencing, state transition diagrams, timing diagrams, priorities among components, handling of interrupts, timing/sequencing relationships, exception handling, concurrent execution, dynamic allocation/deallocation, dynamic creation/deletion of objects, processes, tasks, assembly, storage, deployment, and other aspects of dynamic behavior.

This section describes the concept of execution based on the system components.

4.3 Interface Design

SSDD-4.3.0 :: This section shall be divided into the following subparagraphs to describe the interface characteristics of the system components. It shall include both interfaces among the components and their interfaces with external entities such as other systems, configuration items, and users. Note: There is no requirement for these interfaces to be completely designed at this level; this paragraph is provided to allow the recording of interface design decisions made as part of system architectural design. If part or all of this information is contained in Interface Design Descriptions (IDDs) or elsewhere, these sources may be referenced.

Interface identification and diagrams This paragraph shall state the project-unique identifier assigned to each interface and shall identify the interfacing entities (systems, configuration items, users, etc.) by name, number, version, and documentation references, as applicable. The identification shall state which entities have fixed interface characteristics (and therefore impose interface requirements on interfacing entities) and which are being developed or modified (thus having interface requirements imposed on them). One or more interface diagrams shall be provided, as appropriate, to depict the interfaces.

Unique Interface Descriptions These subsections shall identify an interface by project-unique identifier, shall briefly identify the interfacing entities, and shall be divided into paragraphs as needed to describe the interface characteristics of one or both of the interfacing entities. If a given interfacing entity is not covered by this SSDD (for example, an external system) but its interface characteristics need to be mentioned to describe interfacing entities that are, these characteristics shall be stated as assumptions or as "When [the entity not covered] does this, [the entity that is covered] will.. .." This paragraph may reference other documents (such as data dictionaries, standards for protocols, and standards for user interfaces) in place of stating the information here. The design description shall include the following, as applicable, presented in any order suited to the information to be provided, and shall note any differences in these characteristics from the point of view of the interfacing entities (such as different expectations about the size, frequency, or other characteristics of data elements).

This section describes the internal and external interface design based on the system components.

4.3.1 Interface One

This section describes the internal and external interface design based on the system components.

4.3.2 Interface Two

This section describes the internal and external interface design based on the system components.

CHAPTER 5

Traceability

This section provides traceability of the system components and interfaces to the design requirements.

CHAPTER 6

Schedule

This chapter is ...TBD....

APPENDIX

Notes

ALL-Appendix :: This section shall contain any general information that aids in understanding this document (e.g., background information, rationale, etc.)

This section provides notes, as necessary, to document the system /subsystem design description.