Software Requirements Specification

Smart Building and Receptor for the Blind

KLM5 Corporation

Company Partners:  Karthik Kathiresan  
Loknath Bharti  
Morgan Cooper  
Megha Kumar  
Michael Glienke  
Michael Hausknecht  
Mukhtar Musleh
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   c. Integration Thread Details
I. Assumptions, Limitations and Constraints

a. Assumptions
   - The software developed will be primarily for visually impaired individuals who have no other disabilities.
   - The user will have the physical ability to carry the palm-sized device and walk to their desired end location (destination).
   - The platform off which the software is built will leverage the .NET Framework 3 in order to use voice recognition and text-to-speech functions. Hence, the Operating System used must be Windows.
   - The device will have a power ON/OFF button, however, it will request through a voice command if the user really intended to turn ON/OFF the device prior to executing that task.
   - Device has a connector port to connect to a router to enable a web interface of the Windows Operating System installed on the device to allow for seamless software updates.
   - The device automatically connects to wireless networks and does not need any configuration by the user.
   - Dependence on a large memory consuming Operating System, such as Windows XP, would cause immense power needs, as compared to smaller devices, such as a Pocket PC.
   - The end-user is patient with technology and is willing to learn and update himself/herself as technological advances are made.
   - The maps of the buildings and rooms are very accurate.
   - The end-user is coordinated well enough to follow directions to get to the desired destination.
   - Objects of the same type can be distinguished from one another. Example: Desk A from Desk B.
   - The database which contains the maps of buildings and rooms are immediately updated when a change in the physical environment of buildings or rooms occur.

b. Limitations
   - While the GPS units available to us provide accuracy to a certain extent to determine which door of a building the user has entered, in certain locations, the accuracy might be questionable. In order to be accurate, it has to utilize and sync up with as many satellites as possible. However, when the user is in a location populated with tall buildings, GPS accuracy might be an area of concern.
   - Most of the small internally integrated GPS modules need an external antenna to achieve the accuracy we are seeking. Hence, the technology that supports the
device that is required to provide an accurate mapping and the end user with good
value for the device will rely on this factor.

c. Constraints
   ▪ Have to be small enough to fit in palm-sized device.
   ▪ Have to be efficient enough on power to last a whole day, perhaps more as safety
     precaution.
   ▪ The device should have a minimum memory requirement of 512 MB RAM.
II. Software Architecture Block Diagram

a. Block Diagram Legend

- **Software Module**
- **Internet**
- **Hardware Device**
- **Database**
- **Server**
- **Mainframe**
- **User Device**
- **Laptop**
- **User**
- **Satellite (GPS)**

- **Process Signal**
- **Unidirectional Data**
- **Bidirectional Data**
- **Communication Link**
b. Level 1: High Level Software Overview

[Diagram showing the flow of communication and data processing between various system components.]

- Laptop
- Voice Communication System
- Positioning System
- Mapping Data Storage System
- Internet Cloud
- .NET Mainframe
- Database Storage

User Input to Device and Device Output back to User

Communication protocol between device and Positioning System

Positioning System requires to access GPS through Server(s).

Positioning System uses Data Storage System for database information.

Voice Communication System communicates back to Positioning System to provide user input into digital data.

Voice Communication leverages .NET Framework to communicate with a mainframe.

Data Storage System queries Database.

Connection protocol between Positioning System and GPS Satellite.
c. Level 2: Software Module Block Diagram and Module Description

i. Voice Communication System

- **Sound In**
  A microphone to enable voice input.

- **Speech Recognition System**
  A software module to process the user’s voice and transform it into words and sentences. The .Net Framework 3 would be used to enable the processing.

- **Sentence Processor**
  Software module that will process word and sentence output from the Speech Recognition System and form them into meaningful queries for the query system.

- **Query System**
  This system would send queries through the software interaction interface to interact with the Position System and the Map System.

- **Software Interaction Interface**
  It allows the Position System and the Map System to interact with the speech
i.6 Communication Interface
The Communication Interface serves as a protocol and key interface to enable the Software Interaction Interface to communicate with the Map Interface. This interface defines the protocols to be used between the analog and digital interfaces in the system.

i.7 Map Interface
The Map Interface is leveraged to provide the system with location based outputs, which is then used to produce sentences that the system will output through voice commands for the user.

i.8 Sentence Formation System
This software module will form meaningful sentences from the received information and send that to the Text-to-Speech module. This system primarily uses logical operations in the English grammar to create sentences.

i.9 Text-to-Speech Engine
This module would enable speech synthesis of the sentences sent by the Sentence Formation System using the .Net Framework 3 and send that to the Sound Output.

i.10 Sound Out
A speaker to enable audio output.
ii. Positioning System

ii.1 GPS Module
The GPS Module will output the (x,y) coordinates of the current location with a degree of 2 feet every 500ms. Its physical size will be approximately 34mm*34mm*9mm. It has its on input which simply turns on or off the device. This will be need when the user finally enters their destined building.

ii.2 Accelerometer
It is a hardware device that receives coordinate protocols from the GPS module and transforms that information to its own software interface.

ii.3 Accelerometer Software Interface
This is the accelerometer’s software interface that communicates with the Software Interaction, Communication, and Map Interfaces. This interface is critical in providing information to other pieces of the Position System.

ii.4 Software Interaction Interface
It allows the Position System and the Map System to interact with the speech system.

ii.5 Communication Interface
The Communication Interface serves as a protocol and key interface to enable the
Software Interaction Interface to communicate with the Map Interface. This interface defines the protocols to be used between the analog and digital interfaces in the system.

ii.6 Map Interface
The Map Interface is leveraged to provide the system with location based outputs, which is then used to produce sentences that the system will output through voice commands for the user.

iii. Mapping Data Storage System

(1) Communication Protocol between device and map

iii.a.1 Device connected to USB / Jump Drive
Device used primarily to transfer map information.

iii.a.2 Software device to convert Map to Matrix
Scan document into our software’s format, using the key that we have provided.

iii.a.3 Map stored in storage device
Store map matrix and respective object labels.

iii.a.4 GPS turns off Wii
Simple system that turns GPS off when

iii.a.5 Retrieve map uploaded to memory
When the Wii is turned on, the map for the user’s last known GPS location is retrieved.

iii.a.6 Update position to map
This module constantly updates the user’s position on the map of the building.

iii.a.7 Connect to voice command and output object in room
iii.a.7 Connect to voice command and output object in room
Output protocol of system.

(2) Information Flow

iii.b.1 GPS
Device that communicates user’s position outside buildings. This software module is treated as a simulator.

iii.b.2 Location
Software module that handles data on the user’s location and coordinates. This module receives data from the external Wii device. This module transfers data to the user profile.
iii.b.3 User
   The User software module receives information from the Location module maps this information onto the software’s matrix, through the mapping interface.

iii.b.4 Map
   Software module that receives data transferred from storage device and external voice communication device. The information provided to this module enables the user to appropriately select valid destination points based on their current location.

iii.b.5 Storage Device
   The storage device acts as an intermediary between the mapping interface and the mapping matrix.

iii.b.6 Matrix
   This software module serves the primary purpose of converting maps from any format to our software’s matrix format, which in turn is served as the platform off which the user interface is defined.

iii.b.7 External Storage Device
   Device in the form of an external storage unit to transfer mapping data into a matrix format.

iii.b.8 Wii
   The Wii module has two parts which consist of the accelerometer and the software module that interprets the accelerations and calculates the position based on the latest coordinates given. These coordinates which are stored in the Software Interaction Interface will be given from the GPS right before it turns off and then given to the Wii Module on its start up.

iii.b.9 Voice Communication
   Input from the user in the form of a microphone that translates voice commands to data mapping information for the user.
III. Configurability and Flexibility

As the user is blind, but not physically disabled, there is only one primary operating mode for the user. This operating mode will permit the user to change floor-plans, make any necessary changes in the audio heard (example: change voice from masculine to feminine). There will also be an administrative mode that will permit the user’s aide, such as a parent or teacher, to configure the device to the wireless network and manage any other system administration.

a. User

From a user’s perspective, as there is only one primary mode of operation, the user will have the flexibility to be able to modify personal experiences from using the device. Personal experiences such as the output voice of the device that interacted with the user, the language support provided, the convenience and speed at which the user was able to change floor-plans and configure it to provide directions on getting from point A to point B. As the end-user is blind, it is important to limit the configurability of the device but to provide as much flexibility from the front-end user experience perspective.

b. Aide (Supervisor / Parent / Guardian / Teacher)

The aide of the user will have system administration privileges in order to configure any necessary networks and other administrative protocols to make the user’s experience valuable and productive.

IV. Risks

The time required to develop the specified software system may exceed the estimated schedule due to a variety of reasons. These affecting factors may be caused due to changes such as:

a. Schedule
   (1) further feature requests after the initial design stages
   (2) platform dependent issues that impact deployment
   (3) user specific software customizations

b. Technical
   (1) hardware changes that impact performance
   (2) changes in networking protocols
(3) network modifications that do not have a service pack to assist existing systems to continue functioning
(4) GPS / network coverage not being sufficient in the area where the product is being used
(5) A dependence on Microsoft technologies would prevent any upgrade after Microsoft stops supporting the used Operating System after a period of time
(6) Depending on a prebuilt Operating System, which is much more capable than the required functionality, would lead to extra power and resource consumption

c. Budget
(1) Costs involved in the electronic devices might differ from the estimated costs quoted in the System Specification
(2) In order to deliver the product on time, hiring additional software engineers and resources will lead to an increase in total expenditure
V. Change Management

PROJECT CHANGE REQUEST FORM

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<tr>
<td>Project Name:</td>
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<td>Requestor Name:</td>
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<td>Date (mm/dd/yyyy):</td>
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**Area of Change:**

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<th>Schedule</th>
<th>Budget</th>
<th>Other</th>
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**Proposed Change [Description]**

**References to Software Requirements Specification:**

**Technical impact of proposed change:**

**Budget impact of proposed change:**
# PROJECT CHANGE REQUEST FORM (INTERNAL USE ONLY)

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## Review Status:
- Approved [ ]
- Rejected [ ]
- Defer until [ ] (mm/dd/yyyy)
- Other [ ]

## Cost / Schedule Analysis

### Impact on Cost:

### Impact on Schedule:

### Action Items:

### Priority:
- High [ ]
- Medium [ ]
- Low [ ]

## Resource Allocation:

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## Final Review and Approval:
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### VI. Cross Reference Listing

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<tr>
<th>Functional Requirement Number</th>
<th>Functional Requirement</th>
<th>Module Number</th>
<th>Module Operation</th>
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<tr>
<td>III.a.i</td>
<td>Tablet Screen Navigation – Fingertip Trace</td>
<td>ii.1, ii.2, ii.3, ii.4, ii.5, ii.6</td>
<td>GPS Module, Accelerometer, Accelerometer Software Interface, Software Interaction Interface, Communication Interface, Map Interface</td>
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<td>III.a.ii</td>
<td>Tablet Screen Navigation – Screen Tap</td>
<td>ii.1, ii.2, ii.3, ii.4, ii.5, ii.6</td>
<td>GPS Module, Accelerometer, Accelerometer Software Interface, Software Interaction Interface, Communication Interface, Map Interface</td>
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<td>III.b.i</td>
<td>Voice Recognition – Tablet PC</td>
<td>i.5, i.6, i.7, i.8, i.9, i.10</td>
<td>Software Interaction Interface, Communication Interface, Map Interface, Sentence Formation, Text-to-Speech Engine, Sound Out</td>
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<td>III.b.ii</td>
<td>Voice Recognition – User Speaking</td>
<td>i.1, i.2, i.3, i.4, i.5, i.6, i.7</td>
<td>Sound In, Speech Recognition System, Sentence Processor, Query System, Software Interaction Interface, Communication Interface, Map Interface</td>
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<td>III.c.i</td>
<td>Electronic Wheelchair – Tablet PC Control</td>
<td>iii.a.1, iii.a.2, iii.a.3, iii.a.4, iii.a.5, iii.a.6, iii.a.7, iii.b.1, iii.b.2, iii.b.3, iii.b.4</td>
<td>Device connected to USB/Jump Drive, Software device to convert map to matrix, Map stored in storage device, GPS turns on/off Wii, Retrieve map uploaded to memory, Update position to map, Connect voice command and output object, GPS, Location, User, Map</td>
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<td>iii.b.5</td>
<td>Storage Device</td>
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<td>iii.b.6</td>
<td>Matrix</td>
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<td>iii.b.7</td>
<td>External Storage Device</td>
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<td>Wii</td>
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<td>iii.b.9</td>
<td>Voice Communication</td>
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VII. Integration Thread

a. Integration Thread Block Diagram

b. Sample Room Digital Key

LEGEND
1—Wall
2—Doorway
3...
4...
c. Integration Thread Details

The integration thread for the Software Requirements Specification includes a basic digitized key of a room where an algorithm substitutes key values for objects in the room. By having this key for any given room, it provides an interface for the mapping module to communicate with the voice recognition system. It is not necessary to implement the voice recognition system as a part of the integration thread as the dependencies are high for an external device such as this. Hence, my merely restricting the integration thread to a room’s description and while tracing a mouse over it, the output can simply be words printed on the screen that describe the room’s objects.

An integration thread of this nature will provide the customer with a solid understanding and demonstration of what capabilities and features the end product will hold. This integration thread can serve as the foundation for the remainder of the system to be built upon as the basic and most significant functionality will hold with this integration thread. Hence, any further feature/software module development can be developed off this platform.

The integration thread will include ‘placeholders’ for software modules such as the voice recognition and GPS system to be developed from. Hence, with the integration thread being well defined and providing a fundamental platform for the system, it will serve our customers and developers well.