



HIKARI SYSTEMS CORP.

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June 25, 2001

Dr. Andrew Rawicz  
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Re: ENSC 340 Indoor Positioning System Functional Specification

Dear Dr. Rawicz,

We have developed the attached *Functional Specification for the Indoor Positioning System* based on the proposal you received last month. It includes an elaborate description on how the system will behave, its features, and items to be tested during development.

The specification encompasses a wide scope of considerations with varying priority during development. To clearly outline our goals during short prototype development timeline, we used distinctive colours to highlight these priorities.

For questions and comments, please contact me at [gwfung@sfu.ca](mailto:gwfung@sfu.ca); any feedback would be deeply appreciated.

Sincerely,

Gregory Fung  
Project Leader  
Hikari Systems Corporation

Enclosure: *Functional Specification for the Indoor Positioning System*



HIKARI SYSTEMS CORP.

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# Functionality Specification for the Indoor Positioning System

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## Executive Summary

Extending the project proposal, the functional specification outlines the functionality and behaviour of the system. Both prototype and production requirements are considered, as well as test and documentation specifications.

The system will consist of a network of uni-directional infrared beacons that transmit a unique location code. A software application running on any PalmOS 3.x device receives these signals and displays the appropriate location on-screen for the user. An additional hardware module adds compass display and voice-message guidance for the user. All components will adhere to appropriate safety and product standards

The transmitters are designed for one-time installation without maintenance, in either indoor or outdoor environments. Its signals, with a five-metre range, do not interfere with existing infrared communication standards. It will be compact, robust, and discrete.

The optional hardware unit for the handheld will be built on the Springboard expansion port standard from Handspring (handspring, 2001). With minimal user effort, the module installs and adds a compass to the screen to help users find their heading, and plays voice messages instructing users at intersections. As a consumer product, it will be compact and cosmetically attractive.

User software will be easy to learn, with context-sensitive help available. Designed for use on a PalmOS platform, the software will contain information about the installed site, such as room identification, floor plans, and route information. Users may search for destinations and be guided to them, or browse the map for information about the locations. Additional features such as compass or audio output can be deactivated using menu commands. Usage models are designed such that the features for visually impaired users are primarily considered.



## Glossary

AAA	Common consumer alkaline battery size, also know as UM-4
CE	Certification mark from European Commission for consumer and industrial products
CSA	International non-profit organisation developing standards for product certification
FCC	Federal Communications Commission of the USA, who regulates use electromagnetic spectrum and noise emissions
Graffiti	Handwriting style recognisable by the PalmOS software
IR	Infra-red radiation, used short-range for line-of-sight digital communication
PalmOS	Operation system for handheld computers by Palm Inc.
PDA	Personal digital assistant, also know as handheld computers
Springboard	Springboard expansion slot standard by Handspring Inc.
Stylus	Plastic-tipped stick used to tap and write on the screen of pen-based handheld computers
UL	Underwriters Laboratories, an independent non-profit product safety testing and certification organisation



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## 1 Introduction

This document contains the detailed functional specification for the Indoor Positioning System (IPS) proposed by Hikari Systems Corp.. (For details of the development and business plan of the IPS, please refer to *Proposal for Development of the Indoor Positioning System*, 2001, or visit <http://www.sfu.ca/~syin>) The document first explains in detail how the IPS operates, with general specifications of the system. Subsequent sections provide a thorough description of each component of the system. Because different user groups use each component in different environments, most requirements are unique to each subsystem. For each component, we discuss general features and functionality, talk about requirements for component testing, and describe the documentation required for development and production.

The specifications for the system prototype, to be completed by the end of August 2001, differ from that for a marketable product in some areas, which is to be manufactured for commercial use. In order to differentiate between these specifications, the requirements are colour-coded. Their meanings are as follows:

**Dark Red** – a basic requirement for the prototype

**Dark Blue** – an ideal feature for the prototype, required for the production version

**Green** – a requirement for the production version that may replace equivalent requirements in the prototype version.

By the end of August, 2001, the development team of Hikari Systems Corp. intends to create a system prototype that will satisfy all basic requirements in **dark red**, and we will strive to achieve as many ideal requirements as possible (in **dark blue**). The specifications for a marketable product (**green**) are not required by the prototype. A rough estimate of the development cost of the system prototype is CAN \$600. This includes hardware and software purchases, as well as other equipment and instrumentation.



## 2 System Overview

As the name suggests, IPS is designed to help determine a user's position in an indoor facility, with features such as guidance to destinations and orientation information. A complete system requires a handheld computer (PDA) to detect pre-programmed signals from a set of signal beacons in the facility. From the signal information, the PDA can determine its location and display it to the user. The components on the handheld are divided into hardware and software modules. The following diagram, Figure 1, illustrates the basic components of the system.

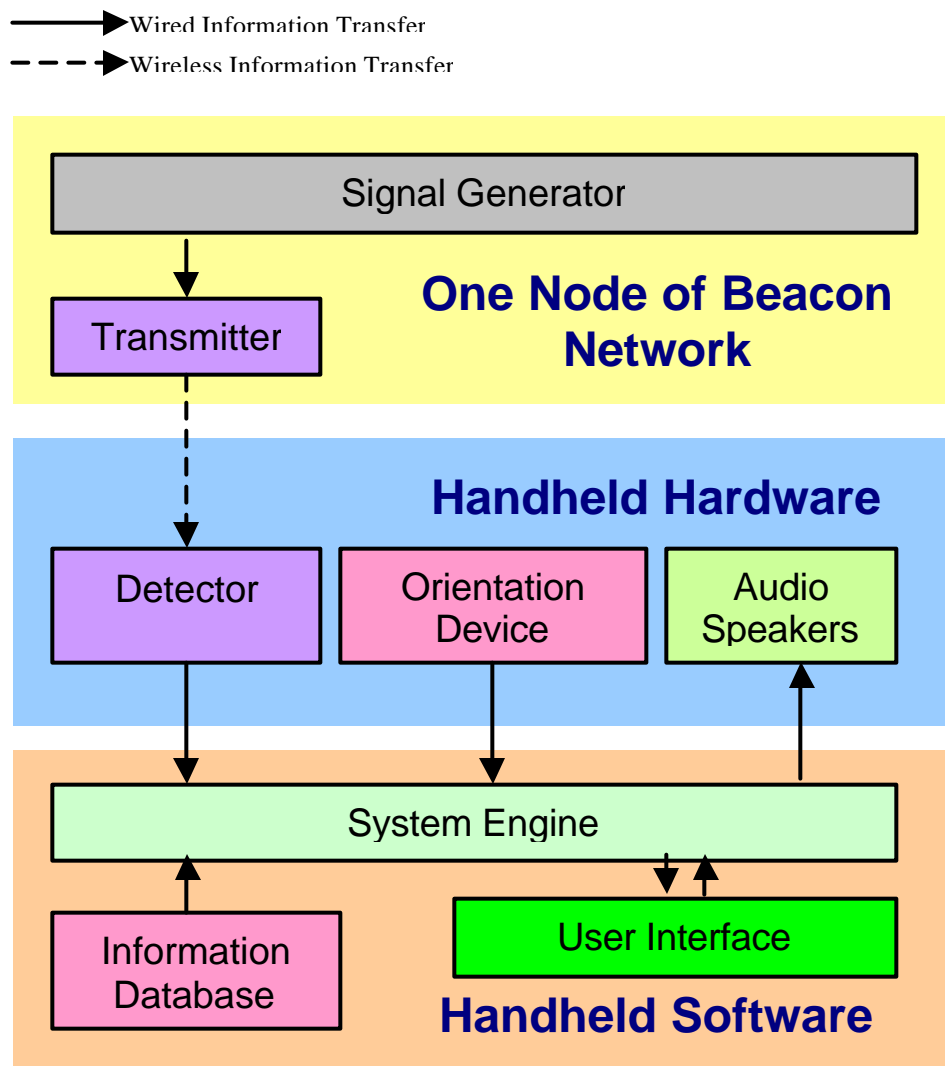


Figure 1. System Block Diagram



To be located at intersections and discrete locations in the facility, each node of the beacon network is responsible for transmitting distinct signals to the handheld for location identification. Each beacon is equipped with a signal generator, which forms a unique signal, and a signal transmitter, which emits the signal periodically. As the handheld passes through an area within the proximity of a beacon, the detector on the handheld receives the signal. The information then propagates to the handheld software, where the system engine compares the signal with that from the information database to determine the location within the mapped facility. The system engine may then provide the user with information such as current location, the shortest route to different destinations, and visual guidance through the user interface. The optional orientation device adds compass direction display, helping the user find their way in an intersection. As a special function on the system, audio guidance is also available to the user, which is especially beneficial to the visually impaired.

## 2.1 Overall System Performance

Since each component of the IPS is unique and has its own functional requirements, they are described in later sections of this document in detail. However, the system as a whole will satisfy the following requirements:

- The basic features of the IPS system must operate on Visor handheld computers meeting the minimum requirements without additional hardware. For information on the minimum requirements of compatible handheld computers please refer to section 4.1.1 of this document.
- The handheld computer, made by a third party, will operate on batteries. Any additional hardware of the IPS system that attaches to the handheld will adhere to similar specifications as the handheld.
- The system prototype will be suitable for indoor facilities where beacons may be placed in distinct locations such that the detector from the user's PDA may conveniently receive the signals emitted by the beacons. Such indoor facilities include libraries, hospitals, shopping centres, school campuses, offices, and multi-level buildings.
- The list of handheld computers that are compatible with the basic features of IPS will be expanded to include any standard handheld computer meeting the minimum requirements without additional hardware.
- The production system will be suitable for both indoor and outdoor facilities.
- The power consumption of each beacon should not exceed that of common household appliances such as radio and television.
- All components of the system will be compliant with the appropriate product certifications where applicable, including electromagnetic interference, user safety and fire-safety standards. These include CSA, UL, and CE certification for commercial and household operation.





- To ensure that signals between the beacons and handhelds are not misinterpreted by other systems, the system will be designed not to interact with other communication systems.

## 2.2 Test Requirements

To ensure that the system complies with the specifications outlined in this document, we can define the following “black-box” tests to verify proper functionality at this time. All feature items can be tested for conformance; where appropriate, test procedures are included below or in the testing section of the appropriate component. As the system components are designed, we can add other tests to properly explore internal functionality thoroughly.

Proper anti-static procedures must be followed during development and testing of the system. While protective eyewear is not required for the testers, static-free straps must be worn when working with any internal electronic components to protect the circuitry from damage.

- The add-on hardware module will be tested for software stability by:
  - removing the module while the handheld is on;
  - removing the module while the handheld is running the IPS program and using the module’s features;
  - removing the module and then turning on the handheld, after turning off the handheld while the IPS program is running.
- The production system will be tested for at least eight hours of consecutive operation.
- The production system will be tried with focus groups in each target audience to identify strengths and weaknesses of the system for their application.

## 2.3 Documentation

Documentation will be included for sales of production units. Since each component of the system is intended for different users and installers, details of documentation are included with the components.

- The manuals will be written for individuals with little experience with handheld computers.
- A Braille version of the manual will be available for the visually impaired.
- User manuals will be available in several languages: English, French, Chinese, Spanish, Japanese, and German.
- The user manual will contain information such as installation instructions, safety instructions, and operation instructions.
- The user manual will be available on the company’s Internet web site.
- Hard copies of the appropriate manuals are shipped with the products.



## 3 Beacon Network and Transmission

### 3.1 Features and Behaviour

#### 3.1.1 Transmission Format

The communication between beacons and the handheld computer must comply with the following requirements:

- Transmission will be uni-directional (from beacon to handheld device only)
- Every transmission signal in any network will be unique
- Data encapsulation (data packets) will be used in the transmission format
- The transmission format must have a high tolerance to transmission errors. The signal received by the handheld is subject to error correction.
- Since the infrared port in standard PalmOS devices are compliant with the IrDA (Infrared Data Association) physical layer standard, Serial Infrared Physical Layer Specification (IrDA, 1998), all physical properties of the signal transmission will be compatible with the standard (i.e. Infrared intensity, transmission wavelength, and range)
- The transmission format will not be compatible with IR systems other than IrDA standard
- All transmissions will be of similar length and format.
- Multiple IPS systems may be consolidated into one system.
- Transmission Format will allow for bi-directional communication

#### 3.1.2 Transmission

- The response time from signal transmission to recognition will be less than 500ms
- Users only need to exert minimal effort in receiving data from the transmitters.
- Ideally, users may point the handheld at any direction, as long as the port is not concealed and the user is within range.

#### 3.1.3 Transmitters

##### 3.1.3.1 General

- The transmitter will send signals to the PDA (Personal Digital Assistant) infrared sensor.
- The range of the transmitters will have approximately 5 meters radius depending on the location.
- Each transmitter will have its own on/off switch
- Range of transmission of each transmitter will be adjustable



### 3.1.3.2 Power

- Power for the transmitters will be supplied by a portable and compact DC source.
- The batteries will provide the transmitter with minimum 8 hours of continuous operation
- Ideally, the maximum power consumption of each signal beacon is 20W.
- Production transmitters will utilise AC power to minimise servicing.

### 3.1.3.3 Physical

- The maximum physical size of each transmitter will be 15x15x10cm.
- The transmitters must be safe – Transmitter case must not have sharp corners, exposed wires or circuitry. Directly looking into an operating transmitter from close range must not cause any physical harm.
- The infrared transmitter will last at least 5000 hours of extensive use.
- The physical shape of the transmitter will provide easy mounting during installation
- The transmitter modules will be aesthetically appealing.
- The transmitter modules will be durable and reliable
- The packaging of each transmitter will allow for easy changing of batteries.
- The transmitters will be easily removable from mounting positions
- The transmitters will have a permanent mount or custom moulding
- Packaging for production version will be even smaller, in the order of 10 x 5 x 5cm.

### 3.1.3.4 Environmental

- The prototype transmitters will be for indoor operations only.
- The transmitter modules will withstand humidity ranging from 10-80%
- The transmitter modules will withstand temperature ranges between 0 and 30°C
- The transmitter will be splash/rain proof upon installation.
- The transmitter will be fully operational at temperatures between –20°C to 50°C.
- The transmitter can be stored at temperatures between –30°C to 70°C.
- The transmitter will be able to handle humidity levels ranging between 0 to 100 % humidity.

### 3.1.3.5 Cost

- Each transmitter module will cost no more than CAN \$20.
- Ideally, each transmitter module will cost no more than CAN \$10.
- Each transmitter module in volume production will cost no more than CAN \$6.

## 3.2 Test Requirements

- The following will be tested for the transmitters:
  - Transmission range
  - Packet content



- Error Checking
- Interference (noise)
- Angle of transmission
  
- Other tests that will be performed include compatibility with palm hardware, battery life and durability testing.

### **3.3 Documentation & Installation Training**

- Documentation will cover how a qualified installer (QI) must install the transmitters. It will be written for an audience of certified electricians in all supported languages.
- Training will be provided for certified electricians to become QIs. The QI will be trained to take interference, range, overlapping of signals, transmitter locations and other mounting issues into account when installing the transmitter network on site.



## 4 Handheld Hardware

### 4.1 Features and Behaviour

#### 4.1.1 PDA requirements

The handheld device, on which the user side of the system is based, is a third-party product and must satisfy the following requirements to support IPS:

- It must have PalmOS version 3.0 or above operating system installed.
- It must have enough free memory for the IPS software and site database (approx. 300KB).
- It must have 4 direct access buttons and a touch screen display.
- It must support a standard PalmOS infrared port.
- It must be able to generate a distinguished audible frequency as a minimum requirement for audio directional guidance.
- For audio and orientation functions, it must have a supported expansion slot to which the hardware module of the IPS may be connected.

#### 4.1.2 Add-on Hardware Module

The PDA hardware add-on module extends the capabilities of the standard PDA to support the unique features of IPS. Prototyped on the Springboard expansion slot of the Visor line of PDA, the hardware add-on module itself contains all the software required for its operation. Shaped as a slim card as in Figure 2, springboard modules slide into a slot in the Visor PDA. Modules can take on various shapes and sizes as required, as seen in Figure 3. Modules for other popular PDAs such as Palm III may be built in the future.



**Figure 2. Rear View of Handspring Visor, showing Springboard Expansion Slot and Card (Handspring 2001a)**



**Figure 3. Other springboard modules currently available (Handspring 2001a)**



#### 4.1.2.1 General

- All standard Springboard module features will be included:
  - The module will not require any tools or special skills to install on the PDA.
  - All software required to use the module is included in the module itself.
  - The software will be automatically installed upon insertion and removed upon removal from the PDA.
  - Once the production module is installed, the unit will be physically and cosmetically integrated with the PDA.
- The prototype module will be compatible with the Visor and Visor Deluxe PDA from Handspring, if not others also.
- Production versions of the module will be capable of storing the entire IPS program and a site database, as well as the module support software, in its on-board memory for quick installation and zero-residue removal.
- Production versions of the module will comply with the appropriate consumer device standards, including FCC Part 15 as a class B home digital device and CE marked as a Class B Digital Apparatus.
- Production modules will be compatible with all systems featuring the Springboard expansion slot.

#### 4.1.2.2 Orientation Device

- The hardware module will contain all software and hardware needed for the PDA to identify the cardinal orientation that the top of the unit faces.
- The hardware module will report the orientation of the device accurate to at least  $\pm 10^\circ$  when the unit is held with the front inclined  $45^\circ$  towards the user, with  $5^\circ$  tolerance in pitch and roll axes.
- Ideally, the orientation reported will be correct if the PDA is inclined between  $0^\circ$  and  $90^\circ$  towards the user in the pitch axis and  $45^\circ$  either way in the roll axis. For an illustration of the geometry, please see Figure 5.
- The software will report the proper orientation within two seconds after the unit is turned in any direction.

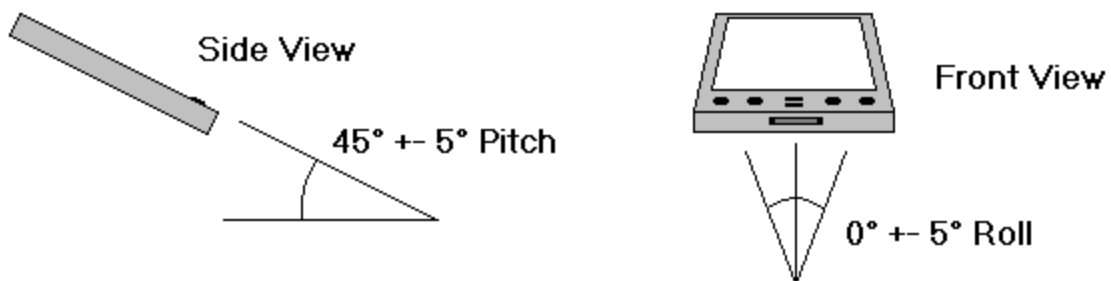


Figure 5. PDA orientation for optimal cardinal directions detection accuracy



#### **4.1.2.3 Speech Output**

- Ideally, the module will contain all hardware and software needed for the PDA to play back pre-recorded voice messages as feedback for the user.
- Vocal messages may be enabled or disabled using software commands
- Vocal output volume level will be adjustable to at least three different levels. The maximum volume level can be heard from 2m away, with the speaker facing away from the user's head, in a normal office environment.
- Vocal playback will be spoken and reproduced so that an English-speaking North American adult can easily understand the message being announced at normal listening distance.

#### **4.1.2.4 Power**

- The module and the handheld will operate continuously for 8 hours with an initially new set of alkaline batteries.
- The module may use a maximum of two extra AAA-sized alkaline batteries
- Ideally, the module will not require batteries of its own, using power from the Visor's batteries.

#### **4.1.2.5 Physical Layout**

- The prototype module must be an integral unit that can be easily held with the handheld, if not installed within it.
- Ideally, the prototype module will be packaged in a slim enclosure that sits mostly within the Springboard slot.
- The production module will be sized 55 x 80 x 40 mm or less.
- When installed, the production module will not impede access to the infrared port, stylus holder, system reset access hole or screen. It will not prevent the unit from being inserted into the desktop cradle. Ideally, it will also allow the use of the snap cover or folding protective cases with the module installed.
- The module will weight less than 150g, with needed batteries installed.

#### **4.1.2.6 Environmental**

- Conforming to the same standards as the Visor handheld, the module will tolerate the following conditions without damage (Handspring 2001b):
  - Operating Temperature: 0 – 40°C
  - Storage Temperature: -20 –50°C
  - Relative Humidity: 5 – 95%
- The production module will be robust enough to withstand falls from 1m and light water splashes without damage to its functionality.



## 4.2 Test Requirements

Since the module is designed to operate with the Visor PDA, the results of these tests may be dependent on the host platform being used. We will perform the following tests with the prototype module on the Visor and Visor Deluxe, and all Visor products for the production modules:

- The module will be tested for response time of the compass display to an abrupt turn of the unit.
- The prototype module will be tested for power consumption by measuring current flows and comparing with battery discharge characteristic curves.
- If automatic software installation and removal is supported, the module will be tested to verify that the module will be ready to use after insertion without any user intervention.
- For the production module, vocal clarity will be confirmed with users of different ages and backgrounds as part of the user trial process.
- The production device will undergo power consumption testing by being operated continuously for six hours with at least five different sets of batteries, using batteries from several manufacturers.
- The production module will be tested for operation throughout the operational temperature range and humidity; after being stored throughout the storage temperature range
- The production module will be checked for damage after being dropped onto various surfaces from a 1m height.
- The production device will be tested for conformance to FCC regulations part 15 as a Class B electronic device for home use.

## 4.3 Documentation

The prototype will have basic instructions for module use in English only. The production module will sold with a brief user manual in all of the supported languages, each occupying roughly 6 pages.

- It will have brief instructions on using the stylus for input, referring to the handheld computer's documentation.
- It will have illustrated instructions on inserting and removing the module from the handheld.
- It will contain instructions for care of the module. It will stress that there are no user serviceable parts inside.
- It will contain specifications for environmental limitations of the module.
- It will list warranty terms and conditions, along with contact information for technical support.





## 5 Handheld Software

### 5.1 Features and Behaviour

#### 5.1.1 System Engine

The system engine is the core of the IPS system. Given user commands and the information database, it determines proper routes and locates the unit within the site. It interfaces with the hardware and interacts with the user.

- The system engine will interpret the incoming beacon signal to locate itself within the site using the database.
- The system engine will determine the closest route from the last detected location to any selected destination within the site.
- If installed, the system engine will interpret the readings of the compass to determine the proper heading.
- The system engine will determine the turns needed to navigate the route and coordinate directional guidance and voice message playback, if supported and enabled.
- System engine interfaces will follow clearly defined protocols to facilitate reusability, platform independence, and simple site set-up
- The system engine will handle interfaces from other applications on the handheld or from the handheld operating system (PalmOS) to ensure compatibility with other applications and smooth operation.

#### 5.1.2 Information Database

The location information database holds data about locations within the site, such as offices, conference rooms, and laboratories. Details about each location may include room numbers, functional or occupant name, and other custom fields such as store genre for shopping centre installations. This information is available for display and may be searched on the handheld by the user.

##### 5.1.2.1 General

- The database will contain information about location of nodes (beacons) installed at the site.
- Since this is the only information source about site layout, the database will provide enough information for shortest route calculation.
- The database will contain a map image of the floor plans for display on the screen.
- The database will store the site name and creation date of the map and site information.
- The database will be in a specific format so that the IPS application can implement a standard method for accessing different site maps.



- For production version, the database will be stored in a format that is compatible with major database programs such as Oracle and MS Access for easy maintenance. Otherwise, tools will be provided to facilitate the conversion.

#### **5.1.2.2 Locations**

- Each location will have the follow information fields:
  - Location name of up to 20 characters
  - Location description of up to 40 characters
  - A customisable field of up to 10 characters, optionally included into the database at site management's request
  - A customisable field of up to 40 characters, optionally included into the database at site management's request
- Each location will be associated with a particular node of the IPS system, to facilitate guidance to the location.
- Ideally, locations are mapped to the floor plan so that users can tap and retrieve information about the location

### **5.1.3 User Interface**

#### **5.1.3.1 General**

The PDA is the part of the IPS that communicates directly with users. To ensure that ease of use and minimal learning curve is achieved, the user interface of the IPS application installed in the PDA will be similar to other Palm OS applications. Users who are familiar of the Palm OS will have a general idea of how to interact with the IPS program even before using it for the first time.

- Users will be able to interact with the application via the touch screens of PDAs.
- For ease of operation and to accommodate the small display size on PDAs, there will be several screens (modes) to display different information or allow different types of input.
- Users can choose from a list of installed location database at the start of the program, and can switch to another database anytime the user wants to.
- The floor plan will be displayed on a separate screen for user reference.
- The guide will be displayed on a separate screen for easy interpretation.
- A separate screen will list information about a particular map in text format for simple searches and information display.
- User will be able to switch between any screens (modes) by tapping on buttons on the PDA screen.
- A brief splash screen will be shown when the application is started
- Help pages will be accessible from every screen.
- Search and route calculations will respond within 5 seconds of execution
- Screen (mode) changes will respond in less than 0.5 seconds.



- Feedback for command inputs will appear within 0.5 seconds. For slow executing commands, the user will be given progress updates so the system does not appear frozen.
- All other reaction times will be less than 0.25 seconds.
- A colour mode will be available and automatically selected for PDAs with colour displays to make the application easier to use.
- Site map files can be downloaded by standard PalmOS file transfer procedures.
- If multiple information databases are found on the same device, users are given a choice of which information database to use.

### **5.1.3.2 Help pages**

To assist the user in using the IPS program, many context-sensitive help pages are included with the program.

- The introduction to usage can be referenced in the help pages
- The help pages will contain a list of features of the system for the user to reference.
- The help pages will contain details of button usage and functions
- The help pages will contain instructions for hardware and software installation written here.
- The help pages will contain instructions for correct usage.
- The help pages will contain troubleshooting tips for the user.
- Help information will be spoken to the user

### **5.1.3.3 List screen**

This screen mode displays information about a particular site, such as room numbers and associated details, in a table format that allows users to easily browse through and select designated areas of the map.

- A sorted list of locations will be displayed in text format.
- Users will be able to select their intended destination by tapping on the items in the list.
- Upon selecting an item from the list, details of the item will be displayed on the same screen.
- Help pages will be accessible directly from this screen.
- Users will be able to choose the field the list is sorted by.
- When users enter text via the PDA writing tool, the cursor automatically jumps to the nearest match to what the user has entered thus far.
- A subwindow will display details of the item the cursor is currently on without user intervention.



#### **5.1.3.4 Maps screens**

This screen mode displays the floor plan (map) of the targeted building, much like printed maps, for reference and selecting destinations.

- The screen will display the floor plan of the building.
- Maps of different floors will be selectable by the user.
- Locations of installed beacons will be displayed on the map.
- The user will be able to view another level of the building by selecting from a list.
- When the PDA is within range of a nearby beacon station, the current location of the PDA will be displayed on the map. An icon will be shown indicating successful reception.
- When the PDA is out of range of any beacon stations, the last recorded location will be displayed on the map.
- If the hardware module is installed, a compass will be displayed on the screen to show the orientation of the PDA (presumably the user as well).
- The user will be able to scroll around the map by pointing and dragging the stylus across the screen.
- Tapping on designated locations on the floor plan will cause a pop-up screen to be displayed, containing details about the selection and an option to choose that selection as a destination for route calculation.
- The user will be able to zoom in and out of the floor plan by tapping buttons on the PDA display.
- A more comprehensive search function will be available for the user to search possible destinations by location properties such as room number, occupant, and equipment.
- Optionally, the map will rotate itself to align with the PDA's orientation.

#### **5.1.3.5 Guide screens**

This is the mode used for displaying the calculated route on the floor plan (map). Users will be mainly referring to this screen when they are following instructions to reach selected destinations. This screen will look be very similar to the map screen; the main difference is that users will not have full control of what part of the map is displayed.

- The screen will display the floor plan of the building.
- The floor of the building currently shown will be shown to the user.
- Locations of installed beacons will be displayed on the map.
- The calculated route to the destination will be displayed on the map.
- The selected destination will be highlighted on the map.
- Directions on how to follow the calculated route will be displayed on the screen.
- When the PDA is within range of a nearby beacon station, the current location of the PDA will be updated on the map. An icon will be shown indicating successful reception.



- When the PDA is out of range of any beacon stations, the last recorded location will be displayed on the map.
- The map will scroll keep the current or last recorded location, as well as the next location in the route, on the screen automatically.
- If the hardware module is installed, a compass will be displayed on the screen to show the orientation of the PDA (presumably the user as well).
- The shortest path will be updated upon arriving at any beacon stations.
- The compass display will be updated at least every 0.5 seconds.
- The user will be able to zoom in and out of the floor plan by tapping on the PDA display.
- Optionally, the map will rotate itself to align with the PDA's orientation, so the user sees the map in the same direction as his view.

#### **5.1.3.6 Features for the Visually Impaired**

- Key features will be accessible with a single button press to ensure sightless navigation of the program screens
- Audible signals will help guide the user to the suggested orientation
- There will be audio feedback to help user with text input.
- Location names will be play backed to the user when requested.
- Audible instructions will be available to update the user on recommended route directions as the user reach a beacon.
- Any audible message or instructions can be replayed by a key press.

#### **5.1.3.7 User-selectable features**

The user will be able to activate or deactivate certain features of the system for both customisation of use as well as hardware/software availability.

- The directional beeps will be able to be enabled or disabled by the user
- The compass may be activated or deactivated by the user.
- The voice output may be enabled or disabled by the user, if supported

## **5.2 Test Requirements**

Testing of the software part of IPS includes tests on all implemented functions against this specifications listed in this document for the appropriate stage of development.

- Response times of various searches and updates will be tested against specifications.
- Testing for compatibility with other system applications installed on the PDA.
- User trial of using the help provided along with the application.



- PDA will be turned off while using IPS, and turn back on to see if the application is in a predicted state.
- IPS application should be in a predefined state when the hardware module is removed from the PDA while in use.
- Test load different maps to ensure the IPS application correctly reads different site maps.
- User trials will be held to assess their learning and usage experiences. Both Palm users and non-Palm users will be studied.
- Visually-impaired user trials will be held. The user will be given minimal training and their experience with the system will be observed.

### 5.3 Documentation

A printed manual will be provided with the software to explain to the user how to install and use the program.

- The prototype will have basic instructions for module use in English only.
- There will be information on how to start and use the program.
- The basic design and usage models will be described with the aid of diagrams.
- The manual will refer to the documentation of the handheld platform when appropriate (for example: details of screen elements and graffiti)
- The information in the help screens will also be included here.
- It will contain information on software copyright and warranty.
- It will contain contact information on how to reach Hikari Systems.
- It will list the minimum requirements of the OS and hardware.
  
- The production module will be sold with a brief user manual in four different languages, each occupying roughly 12 pages.



## 6 Conclusion

The specifications described in this document have been carefully considered to provide economical and useful indoor navigation for users. The development team at Hikari Systems Corp. intends to follow the functional specifications in this document as a blueprint of the project. While this document provides a better vision of our project development than the proposal, it also gives investors and potential customers an in-depth preview of IPS. The functional specifications of IPS are separated into three categories: the basic requirements for a working system, the ideal functions for the prototype due in August, and the specifications of the fully functional production model. We believe that this approach will enable us to better pace our development process, as well as provide a secure basis for future enhancement. As the development team, we believe that by the end of August 2001, we will be able to deliver a system prototype that satisfies all of the basic requirements, if not all prototype specifications.



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