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February 8, 2010

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, BC V5A 1S6

Re: ENSC 440 Functional Specification for DispensAlert™, a Medicine Dispensing Alert System, by Xypnios Innovations Inc.

Dear Dr. Rawicz:

Please find attached the functional specification for the product DispensAlert™ by Xypnios Innovations Inc. We are designing and implementing a device that reminds individuals to take their medication and to dispense the correct combination of medicine at a given time. DispensAlert™ will increase the probability of maintaining a healthy lifestyle.

Our functional specification provides a set of high-level specifications for the system's functionality for its various phases of development. All supporting sections of this document will help justify the demand and viability for this product.

Xypnios Innovations Inc. is a well-balanced company comprised of six multi-talented, innovative, and motivated individuals: Mohammad Abu-Laila, Gary Chiang, Steven Horita, Ryan Laing, Joseph Liu, and Trevor McCauley. I will be more than happy to discuss any additional questions or comments you may have regarding the functional specification. Please do not hesitate to contact me via email at rdl2@sfu.ca or by phone at 604-613-1611.

Sincerely,

Ryan Laing

Ryan Laing
President and CEO
Xypnios Innovations Inc.

Enclosure: *Functional Specification for DispensAlert™—Medicine Dispensing Alert System*

Xypnios INNOVATIONS

DispensAlert

Functional Specification

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EXECUTIVE SUMMARY

In a world where memory loss is an inevitable consequence of aging, it is important for technology to counteract this loss and work towards an effectual solution. At Xypnios Innovations, we will develop DispensAlert, a simple low technology solution that reminds its users to take their medication on a timely basis and as a result, maintain a healthy life style.

DispensAlert allows the user to manually input or scan a barcode to program the unit's dispensing information. DispensAlert consists of two units: the main unit and the wristband unit. The main unit contains the dispensing mechanism and serves as a reservoir for medication. In addition, the main unit consists of a touch screen panel that serves as the user interface for the entire product. The user can easily acknowledge the dispensing or modify the dosage information through the display. The wristband unit is an ergonomically designed and easily adjustable component that resembles a watch. The wristband unit has user-friendly functions that alerts the user at the scheduled time and updates its internal schedule when synchronized with the main unit.

In future iterations of our product, we wish to keep adjusting the dimensions and other parameters of the DispensAlert so that it may become smaller, lighter, and more convenient. In addition, we hope to improve the product's response time, energy consumption, aesthetics, as well as durability and reliability.

The requirements, standards, and layout plans of our first prototype DispensAlert are outlined in the following document. The Xypnios team is committed to deliver a safe, useful, easy to use, and memorable device.

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GLOSSARY

MCU	Microcontroller Unit
MTTF	Mean Time To Failure

1.0 INTRODUCTION

DispensAlert™ is a two-piece electro-mechanical device which is designed to improve the health of medicine-dependent individuals. The wristband unit is designed to remind the individuals to take their medication and updates its memory wirelessly. The main unit is responsible for cleverly dispensing the correct combination of medicine to the user. By scanning in the barcode of medicine label, the device can quickly learn the dosage requirement. Functional requirements for the DispensAlert™ system are outlined in this document.

1.1 Scope

The purpose of this document is to outline the functional requirements that must be met by DispensAlert™ system. The document will describe in detail how the device will interact with the user, what the device will do, and how the device will look like.

The low level implementation methods to achieve the requirements discussed will be out of the scope of this document.

1.2 Intended Audience

The use of this document is targeted towards the design team of Xypnios Innovations Inc. The functional specification provides the framework of the device's intended use and features. The requirements will assist the design team to stay focused on the end-goals throughout the design process.

Later in the design cycle, the project manager can easily assess how close they came to satisfying the functional specifications. At any time, design engineers are able to revert back to this document to answer any application questions about the device.

The detailed functional specification will also be used to explain to Xypnios Innovations Inc.'s executive management about the expectation of the device, namely its capabilities and constraints.

1.3 Functional Requirement Convention

In this document, we will be using the following convention to easily identify and highlight important functional requirements:

[FR-###-X] is a functional requirement

Where, FR = Functional Requirement
= Functional Requirement Number
X = Functional Requirement Priority; 1, 2, or 3

Functional requirement priority numbers denote:

(1) A functional requirement for first prototype unit
(2) A functional requirement for later prototype units
(3) A functional requirement for production units

2.0 SYSTEM OVERVIEW

The block diagram of the DispensAlert™ system is given in Figure 1.

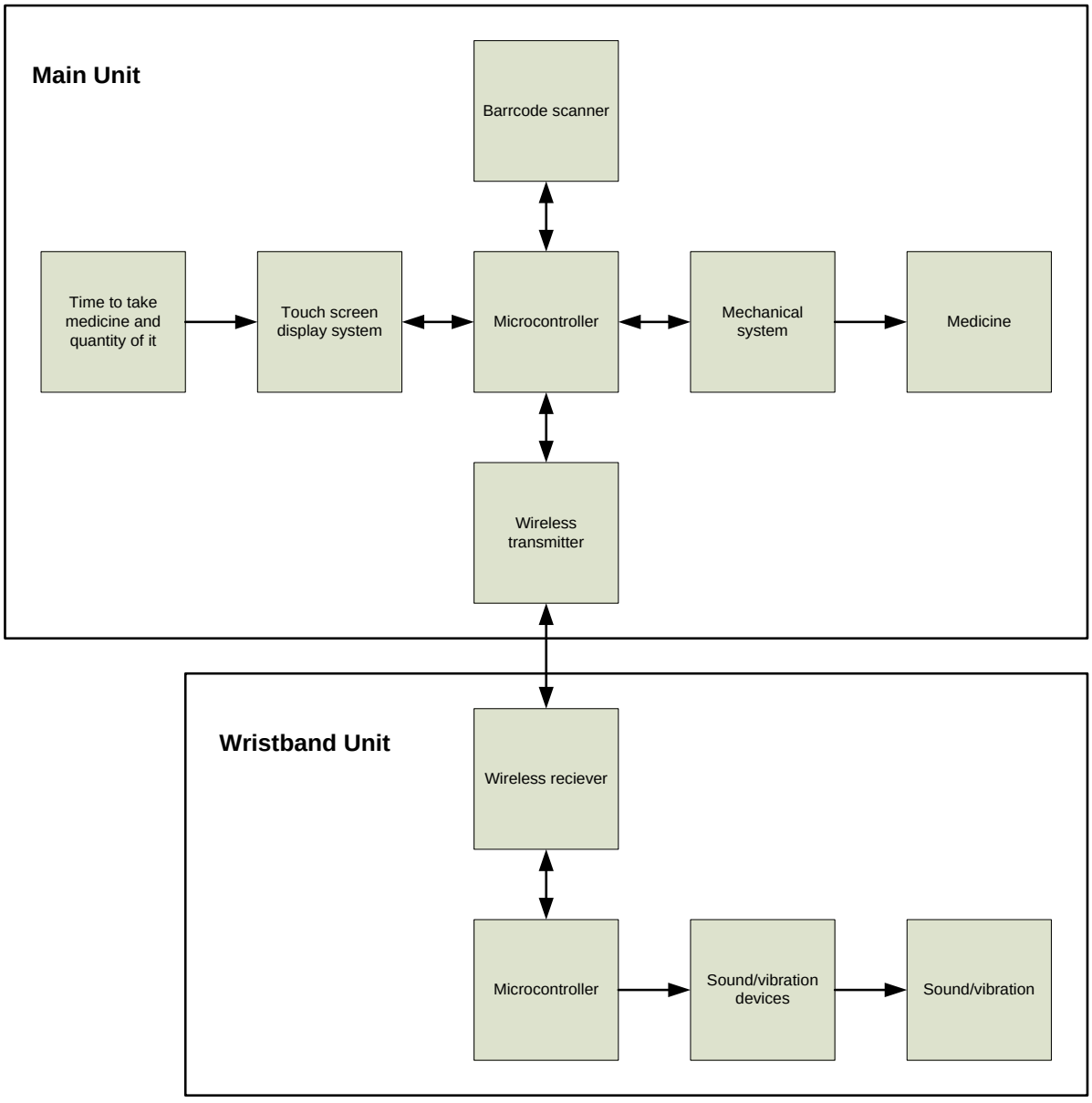

Figure 1: Block Diagram of the DispensAlert™ System

As can be seen, the main unit and the wristband unit can be treated as two different entities with one common interface: the wireless transmitter and receiver. Therefore each entity will be implemented by separate teams to reduce the project's complexity and improve efficiency.

The user interacts with the DispensAlert™ system via the touch screen display embedded into the main unit. This touch screen, which has a two way communication with the microcontroller unit (MCU) is used to enter the required system inputs and to display critical system information. These inputs are the time the medicine needs to be taken and the quantity per intake. As a special feature, such inputs can be encoded in a 2D barcode label, which allows ease of use. The user simply scans the label with the barcode scanner. The MCU receives such data and in turn processes and saves it. The time to take medication data that has been entered is then sent to the wristband unit via the wireless transmitter.

The wireless receiver embedded into the wristband unit accepts the data transmitted by the main unit. The MCU then processes and saves this data and sends control signals to initiate the audible or vibration devices when it is time for the user to take their medication.

When such alerts are issued, the main unit will not automatically dispense the medicine the user needs to take; it waits till the user activates the “dispense” button. This is for safety reasons because it is undesirable to have certain medicine exposed to light and it could be hazardous for children. However, upon activation, controls signals are sent to the mechanical system allowing the correct amount and combination of medicine to be dispensed.

A render of what our finished system might look like is depicted in Figure 2:

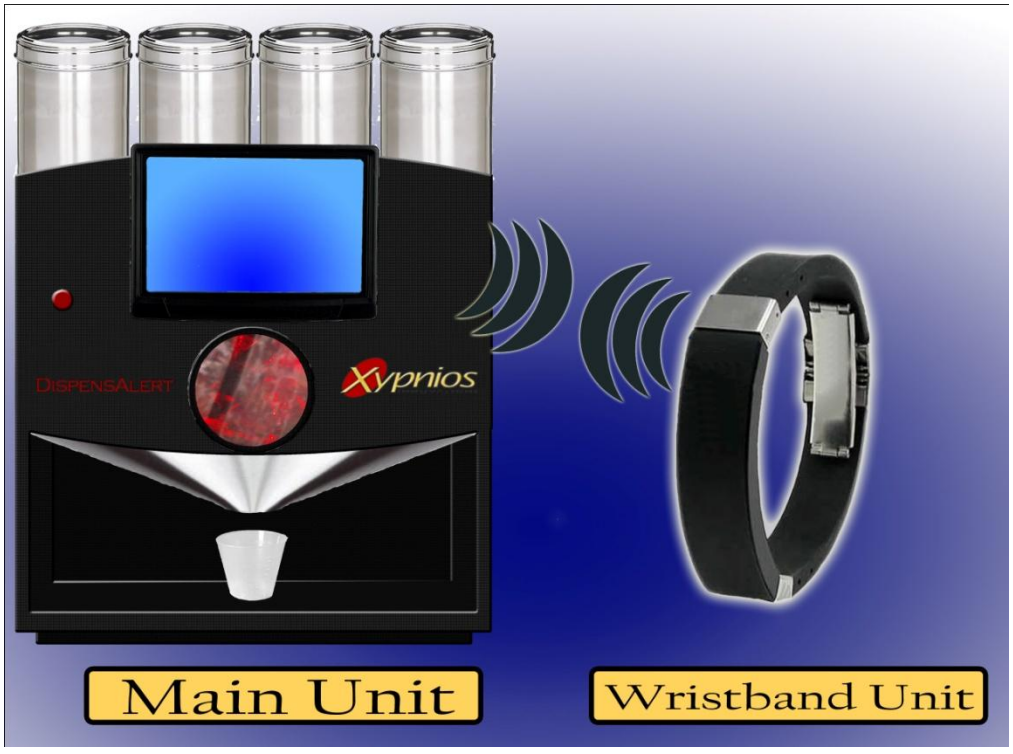

Figure 2: Visual Render of the DispensAlert™ System

3.0 MAIN UNIT

The main unit is the central controlling unit responsible for dispensing the correct combination of medication to the user. It provides a touch-screen user interface for loading the main unit with additional medication, adjusting the dosage requirements, and adding new dosage requirements.

3.1 General Requirements

[FR-001-3] The retail price of DispensAlert™ shall be under $200.00 CAD.

[FR-002-1] The unit shall act as the user interface for the entire DispensAlert™ system.

[FR-003-1] The unit shall dispense the correct combination and quantity of medicine according to dosage requirement.

[FR-004-1] The main unit shall be able to read barcode input from prescription labels.

[FR-005-1] The unit shall store user settings such as date and time.

3.2 Physical Requirements

[FR-006-3] The unit shall encapsulate all electro-mechanical components in a plastic enclosure.

[FR-007-3] The unit shall have an enclosure which prevents contamination of medicine sensitive to light.

[FR-008-2] The length of the unit shall be no more than 35 cm.

[FR-009-2] The width of the unit shall be no more than 25 cm.

[FR-010-2] The height of the unit shall be no more than 25 cm.

[FR-011-2] The weight of the unit shall be no more than 2 kg.

[FR-012-3] The unit shall have no more than 3 distinct colors, excluding touch-screen display output.

3.3 Electrical Requirements

[FR-013-1] The power supply shall provide sufficient DC voltage at the maximum load condition.

[FR-014-3] There shall be voltage test points for easy troubleshooting and validation purposes.

[FR-015-1] The unit shall be powered with a wall supply of 110V/120V at 60 Hz.

[FR-016-3] The unit shall have a back-up power system in case of a power outage.

[FR-017-2] The power cord shall be no longer than 1.5 m from the main unit to the wall socket.

[FR-018-3] The unit shall not have a power consumption of more than 300 W. (Bluejay, 2009)

3.4 Mechanical Requirements

[FR-019-1] The unit shall have separate reservoirs to store different medications.

[FR-020-1] The unit shall have hinged doors to cover the reservoirs.

[FR-021-1] The hinged door shall have a simple locking mechanism to prevent unauthorized access.

[FR-022-1] The unit shall utilize stepper motors and a funneling mechanism to dispense the medicine.

[FR-023-1] The unit shall be designed to rest upon a flat level surface.

[FR-024-1] All medications shall be funneled down to one main dispensing point.

3.5 Environmental Requirements

[FR-025-3] The unit shall operate normally at an elevation height no greater than 1000 m above sea level.

[FR-026-2] The unit shall exhibit a normal operating temperature range of +5^{o}C to 45^{o}C (Kramer Electronics, 2001).

[FR-027-2] The unit shall operate normally at a relative humidity range of 5% to 65%, non-condensing (Kramer Electronics, 2001).

[FR-028-1] The unit shall be used indoors only; away from any liquids and open flames.

[FR-029-2] The unit shall not operate with full load at a noise level of greater than 45 dB (Chin, 2003).

3.6 Reliability and Durability

[FR-030-3] The MTTF (Mean Time To Failure) of the unit shall be no less than 25,000 hours.

[FR-031-2] The unit shall be operational and resilient to damages from normal usage.

[FR-032-3] The stepper motors shall be operational after no less than 15 million cycles (Haydon Motion Solutions, 2010).

[FR-033-2] The touch-screen display shall withstand stress incurred through normal usage.

[FR-034-3] The unit shall be operational from no more than a 2 meter shock test.

[FR-035-3] The unit shall be operational after a 1 minute vibration test.

[FR-036-3] The unit shall be operational after a high potential test.

3.7 Safety Requirements

[FR-037-1] The medicine shall be easily accessible in case of a system failure.

[FR-038-2] The unit shall not cause damage to the medicine it holds.

[FR-039-1] The unit shall dispense medicine only when prompted by the user.

[FR-040-2] The unit shall not cause bodily harm to the user.

[FR-041-2] The unit shall give the user feedback regarding errors, unless there is an electronic or total system failure.

[FR-042-2] The electronic and mechanical components and connections shall be enclosed to prevent electrocution and other bodily harm.

[FR-043-2] The components of the unit shall be made of non hazardous material.

3.8 Performance Requirements

[FR-044-2] The unit shall dispense medicine within 5 seconds of being prompted to do so.

[FR-045-2] The unit shall give the user general feedback such as system's current state.

[FR-046-2] The unit shall indicate its power status.

[FR-047-3] The unit shall display new information on touch screen display within 1 second.

[FR-048-3] The unit shall go to sleep mode when not being used or when no medicine is to be dispensed.

[FR-049-1] The unit shall transmit wireless data to the wristband unit when there is new data and the wristband unit is in close proximity.

3.9 Usability Requirements

[FR-050-2] The unit shall have space to place a small cup below the main medication dispensing point.

[FR-051-2] When activated the touch screen will display the main menu.

[FR-052-2] All major programming functions will be able to be accessed from the main menu.

[FR-053-2] The unit will be able to be programmed for a new medication using a process no more than five simple steps long.

[FR-054-2] All steps shall flow intuitively from one to the next.

[FR-055-2] The barcode scanner shall scan most labels on the first attempt.

[FR-056-1] The graphical user interface shall be well designed and intuitive.

[FR-057-1] Deployment of system shall be non-invasive to the user's lifestyle.

[FR-058-3] The learning period of the system should be no more than 10 minutes.

[FR-059-2] The system should be easily used by a wide demographic.

3.10 Luxury Functions

[FR-060-1] The unit shall not look out of place on a high-end kitchen countertop.

[FR-061-1] The unit shall be elegant but not noteworthy in a home.

[FR-062-2] Medication containment shall be sealed watertight.

[FR-063-2] A small amount of water sprayed on top of the device shall not interfere will proper device operations.

[FR-064-1] The device shall have a stainless steel finish, according to current kitchen appliance trends.

[FR-065-3] The system allows users to setup multiple accounts.

4.0 WRISTBAND UNIT

The wristband unit alerts the user, at designated times, to take their medication regardless of where the user is relative to the main unit. When the user dispenses their medication from the main unit, the wristband is updated with the next scheduled alarm. This broad specification has several implications which are reflected in the requirements of the wristband unit.

The following are required of the wristband unit in its various iterations and of the final product:

4.1 General Requirements

[FR-066-3] The wristband shall be adjustable to fit a variety of wrist sizes.

[FR-067-2] The wristband shall sound alarms every 10 minutes if not brought to the main unit after an alarm has been indicated.

[FR-068-2] The wristband functions shall be user friendly.

[FR-069-3] The wristband shall be ergonomically designed.

4.2 Physical Requirements

[FR-070-3] When worn, the wristband shall not extend to a height above 2cm.

[FR-071-3] The weight of the wristband shall not exceed 200 grams.

[FR-072-3] The wristband shall be aesthetically pleasing.

[FR-073-3] The wristband strap shall be made of durable and comfortable material.

4.3 Electrical Requirements

[FR-074-1] The unit shall be powered by two “AAA” batteries.

[FR-075-1] Key voltage nodes will be easily accessible on the unit for troubleshooting, debugging and testing purposes.

[FR-076-3] The unit shall incorporate power saving measures.

4.4 Mechanical Requirements

[FR-077-2] The wristband shall have a button to cease alarms.

4.5 Environmental Requirements

[FR-078-3] The unit shall operate equally well indoors and outdoors.

[FR-079-3] The system shall be operable in relative humidity up to 90% (non-condensing).

[FR-080-3] All electrical wiring shall be enclosed in protective casing.

[FR-081-2] The unit shall produce little or no noise when in use or standby (with the exception of alarms).

[FR-082-2] The unit shall operate normally in the presence of and not in interference with other equipment that utilizes UHF technology.

4.6 Reliability and Durability

[FR-083-3] The wristband will be sufficiently protected in order to withstand general wear and tear.

[FR-084-3] The wristband shall be able to be dropped from a height of 3 meters and still be functional.

[FR-085-3] All electromechanical components will be shielded in a protective material to prevent damage.

4.7 Safety Requirements

[FR-086-1] The batteries will be housed in an appropriate casing.

[FR-087-1] The system shall not discharge its batteries on the user.

[FR-088-2] All sharp edges will be dulled and covered in a protective coating.

[FR-089-2] All electrical components will be encased in non-hazardous materials.

4.8 Performance Requirements

[FR-090-1] The push buttons to interact with the wristband will require minimal force from the user to be activated.

[FR-091-1] The wireless module will receive data when within a few meters of the base station, requiring no trigger from the user.

[FR-092-1] The vibration mechanism will be sufficiently strong enough to trigger sensation but not too strong to cause discomfort.

[FR-093-1] The buzzer alarm will be sufficiently loud to prompt the user to take their medicine but will not be too loud to cause harm or disorientation.

4.9 Usability Requirements

[FR-094-1] The learning curve for the wrist band will be very shallow.

[FR-095-2] The push buttons will be mapped similar to a watch for ease of use.

[FR-096-3] The wristband will be operated with ease by an older demographic.

[FR-097-3] The wristband will be simple to integrate into the users daily activities.

4.10 Luxury Functions

[FR-098-3] The wristband will look similar to a watch and be as streamlined as possible.

5.0 USER DOCUMENTATION

[FR-099-2] User documentation will include a user manual that will be written for an unknowledgeable audience in the field of electromechanical devices.

[FR-100-3] The user manual will be provided in multiple languages to satisfy language requirements in international markets (i.e. French, Spanish, German, Japanese, etc.).

[FR-101-3] A highly detailed and properly documented operation guide will be created for production companies, technicians and retailers.

[FR-102-3] A website with will be created to provide general and technical support as well as answer any questions a user may have and provide a digital copy of all the documentation mentioned above.

[FR-103-3] The website will be written in English and French.

6.0 SYSTEM TEST PLAN

The DispensAlert™ proof-of-concept prototype will undergo three stages of development testing. The initial stage will involve testing of individual components to ensure their good working order as well as to gather operational knowledge of each component. Each unit will then be assembled and tested separately as individual systems. Next, the entire device will be integrated and we will test the ability of the units to work with each other. After, we will conduct qualitative testing, employing a holistic method involving typical use scenarios. Finally, we will conduct failure testing, to ensure that when the end-user performs an illegal action an appropriate error message will be given.

6.1 Individual Component Testing

MCU:

- Ability to connect to programming PC
- Ability to connect to and function from power from wall socket
- Ability to stay powered for extended periods of time without failure
- Ability to contain programs
- Ability to run programs without fault
- Ability to output data to peripherals

Touch screen Unit:

- Ability to detect a human digit
- Ability to detect correct location when pressed
- Ability to display the GUI as programmed

Wireless Module:

- Ability to transfer data between units
- Ability to sense when in range
- Ability to power receiver via AAA batteries

Wristband Circuitry:

- Ability to power unit via AAA batteries
- Ability to store a time
- Ability to count down
- Ability to vibrate

Barcode Scanner

- Ability to scan normal barcode
- Ability to output data

6.2 Integration Testing

Main Unit:

- Ability to set a timed release of medication
- Ability to add new medication
- Ability to change time schedule
- Ability to interact with wristband unit
- Ability to read in and store data from barcodes
- Ability to use data from barcodes constructively
- Ability to know which pills should be dispensed
- Ability to track how many pills of each type remain
- Ability to dispense correct number of pills without incident
- Ability to provide useful error messages to user
- Ability to return to a low power state when not in use

Wristband Unit:

- Ability to set alarms wirelessly
- Ability to keep track of saved alarms
- Ability to notify wearer at correct time
- Ability to function on low power
- Ability to notify user when batteries should be replaced

6.3 Qualitative Testing

We will conduct thorough hardware and software testing to ensure that all modules have been integrated properly. We will confirm that the device complies with our requirements listed in sections 3 and 4 of this document. In addition, we will employ a Typical Usage Scenario, outlined below, which emulates the intended use of the device by the end-user. During the test, we will ensure that each step of the usage scenario is functioning as intended.

Typical Usage Scenario:

1. User plugs in the main unit and inserts batteries into the wristband.
2. User loads medication into main unit.
3. User enters pill scheduling information.
4. Wristband alerts user to take medication.
5. User cancels alarms and returns to main unit for medication.
6. Next alarm is sent to the wristband.

6.4 Failure Testing

During this phase we will attempt to think of any improper usage the device may encounter while being used by the consumer. Any types of improper usage which could result in catastrophic failure or the endangerment of the consumer's life will have programming in an effort to prevent or mitigate the effects of improper usage by preventing the action and producing error messages. An example of this would be if the user attempted to press many buttons at once in an effort to have the device output more medication than the prescribed dosage. We will see that this situation is possible and include in the programming an error message to appear whenever the machine feels more than one button has been pressed at once. When this programming is in place, that way of confusing the device in order to obtain excessive medication will have been prevented.

7.0 CONCLUSION

Xypnios Innovation believes DispensAlert™ is a product that every senior citizen should have. The functional specifications mentioned in this document will provide the guideline of the requirements during the product design, development, and testing stages. The functional specification clearly defines the capabilities and requirements of the DispensAlert™ medicine dispensing system.

8.0 REFERENCES

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