Safe Steps

DESIGN IDEA

Safe Steps aims to reduce the chances of accidental falls at home. The main factors that led us to take this decision were:

- One of the main fears for Jonathan is to have a fall accident and losing his level of independence. So our idea is influenced by user influence and follow a human-centered design.
- Our proposed design idea enhances active aging in multiple ways, such as: security, health, quality of life, and independence.
- Our Idea is intended for domestic spaces and matches user research findings
- Our idea does not contravene social, legal and ethical issues
- Our idea provides an innovative solution to the problem of accidental falls at home especially by elderly people.

Safe Steps can be described as a product that helps safety-concern elderly people to reduce the chances of falling by providing real time visual, haptic and sound notification about waking patterns anomalies and surrounding hazards, using a pair of slippers and a digital wearable device wireless interconnected that bring people peace of mind that walking at home is safe.

PROPOSED FINAL DESIGN

Safe Steps supports the goal of providing a safe walking experience in home environments by reducing the chances of having a fall accidents with real-time notification of walking anomalies and hazards. Safe steps have three components:

1. Nanosensor slippers
2. Digital wearable device
3. Web cloud platform

Nanosensor slippers

The pair of slippers will support Wi-Fi to connect to the Internet, Bluetooth to connect to the wearable device, and will have nanosensors embedded in them. These sensors will have two functions. Firstly, they will help in detecting risky substances and surfaces that can potentially cause falls. Secondly, these sensors will also help in measuring walking patterns which will be recorded on a Cloud platform and will be analysed in real-time. This data analysis will assist user in detecting walking pattern anomalies, warning the user of the risk of a fall and providing relevant exercise suggestions. Identity of the users will not be shared by the components on the Cloud to maintain confidentiality (see Figure 4).

Figure 4. Safe Steps slippers

Digital wearable device

The wearable device will be mainly used to provide haptic, visual and sound notifications and recommendations to users in real-time (see Figure 5). It will automatically connect to the slippers when they are active. Both the devices will not require much technological knowledge as they will be just required to switched on for using them. This will make it very user friendly and will reduce the cognitive load on the users especially on elderly users. The wearable device has a digital screen and physical buttons which user can interact to perform actions such as: acknowledge notifications, view exercise recommendations, reach emergency contacts, etc.

All user interactions are detailed explained on Digital Prototype section (Page ??)

Figure 5. Safe Steps wearable device

Web cloud platform

The cloud platform records, manages, and analyse the data sensed with nanosensor slippers which is sent through internet and consolidated for interpretation. Real-time data analytics engines run to detect anomalies in user walking patterns and generate appropriate notification to alert the user of potential risky situations when walking. In addition, this platform is responsible for storing and synchronizing user settings and events, which can be accessed anytime and anywhere, for example when a doctor require to evaluate walking pattern records in order to provide a more efficient medical diagnosis.

Figure 6. Safe Steps cloud

(Table 1) explains the link between Safe Steps main features, the justification for each feature and Persona main needs/problems identified through user research:

Main Features	Justification	Main Needs/Problems
Appealing, Robust and light digital waterproof wearable device	A wearable device on the wrist matches the conception of using analog watches (User familiarity), which we identified as a common pattern for elderly people	Jonathan struggles with complex and unfamiliar technologies
Comfortable cutting-edge nanosensor slippers	Nano chemical and pressure sensors can be embedded in the slippers sole and are the latest technology to measure walking patterns and detect risky substances.	Jonathan desires to have a safer home environment and be able to detect risky situations to prevent fall accidents
Wireless support for wearable device and nanosensor slippers	Both devices will share data by a wireless mean which will reduce cognitive load of having multiple steps to plug or set up a device connection. It also provide speed of operation and adaptability in terms of system performance.	Jonathan struggles with complex and unfamiliar technologies
Real-time visual, haptic and sound notification for walking pattern anomalies	Notifications will support the user understanding and clearly communicate the situation and what is expected from the user to do.	Jonathan struggles with complex and unfamiliar technologies
Real-time visual, haptic and sound	Notifications will support the user understanding	Jonathan struggles with

notification for risky surfaces and surrounding hazards	and clearly communicate the situation and what is expected from the user to do.	complex and unfamiliar technologies
Web Cloud platform to provide powerful data analysis of user walking patterns	Data collection, analysis, interpretation should be "invisible" for user. This process does not require user interaction. However, the outcome is what really matters for user because will valuable date he can increase his knowledge and awareness of his physical condition.	Jonathan wants to be independent and physically active for future
Web Cloud platform to record and track user walking events	To access user walking events anytime, anywhere by digital means speeds up the process of storing, maintaining and distributing health data with doctors and medical services.	Jonathan gets frustrated for spending much time in visits to doctors
Share walking events with medical services	To access user walking events anytime, anywhere by digital means speeds up the process of storing, maintaining and distributing health data with doctors and medical services.	Jonathan gets frustrated for spending much time in visits to doctors
Customized physical exercises recommendations	Every time a walking pattern anomaly is measured, detected and notified to user, Safe Steps will prompt physical exercise suggestions that match the anomaly discovered with the aim of reducing the chances of future recurrences.	Jonathan wants to be independent and physically active for future
Remote Tracking of wearable device and nanosensor slippers	If user by any chance loses either the slipper or the wearable, he can track and find them using the web cloud platform. The wearable device also has an option to find the slippers at home.	Jonathan desires to have a safer home environment
Fast wireless charging support	When wearable device is located in proximity of a wireless charging device, it will start charging automatically if they are not in use. This feature helps on reducing the cognitive load to the user.	Jonathan struggles with complex and unfamiliar technologies
Emergency contacts management	User can save emergency contacts, create groups and set up communication channels using the wearable device. All this data is backed up in the cloud platform.	Jonathan hopes to trust in emergency services rapid reaction
Emergency Notification to rapidly reach emergency services and contacts in case of a fall accident	With a simple button user will trigger an emergency notification to emergency contacts predefined. User will be prompt with appropriate feedback to know when notification successfully received, which contacts receive it, and the expected time to receive assistance	Jonathan hopes to trust in emergency services rapid reaction

Table 1. Product features/User needs matrix

NETWORKED ECOSYSTEM DIAGRAM

Safe Steps design idea is aimed to be used in domestic spaces, as mentioned before it includes three components (slippers, wearable device, cloud platform) that are interconnected and share work and data between them using networked technologies. Without going deep in technical details, these are the main technologies used for Safe Steps:

- Wi-Fi (Wireless Internet) transmission
- Ethernet (Wired Internet) transmission
- Chemical Nanosensors
- Pressure Nanosensors
- Bluetooth Class 1 (100 mts range) transmission
- GPS Location
- Cloud computing
- Routing

Figure 7 represents the networked ecosystem diagram with the main technologies used to share data and connect different components. Please note that internet router is not part of Safe Steps, but it is required to include as it allows Safe Steps components to exchange and synchronize data with cloud platform.

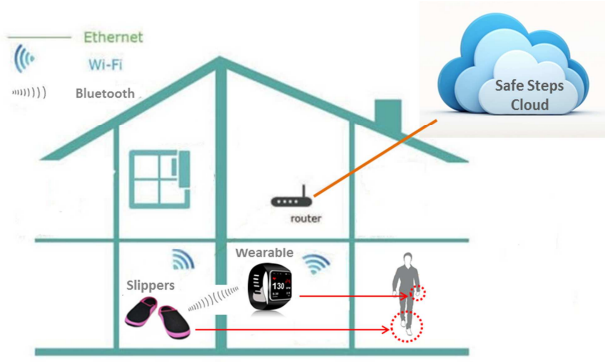

Figure 7. Networked Ecosystem

Each component in our networked diagram support different user activities, have a different behaviour and provide different input and output experiences for user.

Safe Steps - Nanosensors slippers

The main inputs (see Table 2) and outputs (see Table 3) means for slippers are described below.

Inputs
Physical button to turn on/turn off the device.
Socket where user plug the charger the recharge device, wireless charging option is also available

Table 2. Safe Steps slippers inputs

Outputs
Led lights panel (see Figure 8) to provide visual output in the form of lights of different colour: ● Green when they are active and working properly ● Yellow if it is related to a problem related to users way of walking ● Red if any hazard is nearby ● Blue when slippers are been charged
Audio output with limited word for example wet floor ahead when the user is not wearing the wearable. It also provide an beep sound when user need to locate it by cloud platform or wearable device

Table 3. Safe Steps slippers outputs

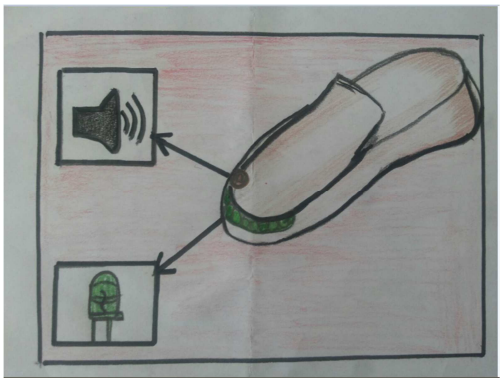

Figure 8. Safe Steps slippers sketch

Safe Steps - Digital wearable device

The main inputs (see Table 4) and outputs (see Table 5) means for digital wearable device are described below.

Inputss
User recognition and identification system by voice.
Pointing device - Touch screen to tap multiple icons and navigate between interface screens.
Physical buttons to press and crown to rotate. One emergency button is activated when user press it for more than 1 second and trigger an emergency notification to predefined contacts. One lateral button to unlock screen. One lateral crown to set up time similar to an analog watch.

Table 4. Safe Steps wearable inputs

Outputs
Haptic output that stimulates the sense of touch.
Device Vibration can be an optional notification mechanism.
Sound notification for most user interactions and alters of walking anomalies and hazard identification. Our target users may have sight problems. Sounds will be beeps and speech output for short sentences like “Wet surface!”
Two-dimensional textual output and feedback on digital screen.
Two-dimensional Video/Animation/Moving pictures output supported by audio on digital screen when user is recommended easy physical exercises.

Table 5. Safe Steps wearable outputs