sHike: Smart Hiking

A smart cloud and mobile platform appliance for the safety and health in mountain hiking

Introduction

Every year, millions of tourists visit the Alps or other Italian mountain locations and hiking resorts.

A large proportion of these tourists, during their stay, walks and hikes the local trails – but they mostly do so without physical preparation and with little or no knowledge of the trail. This exposes a large number of people to the mountain environment without adequate preparation and information. This, in turn, causes a large number of calls to the Italian Alpine Rescue (many of such calls result from a naive approach to the mountain with a result of loss of orientation, delay or exhaustion).

It is estimated that a very large number of tourists, even without calling the Alpine Rescue service, every year suffer exhaustion, loss of orientation and other unpleasant experiences which make their stay in our territory less pleasant as it should be.

The sHike project aims to develop a platform supporting tourists and hikers using advanced wearable and cloud technologies in their hiking activities, so that their physical health and location can be monitored, with the ultimate result of making their experience more enjoyable and safe.

Abstract

The sHike project targets the development of a smart platform for sports and recreational activities in mountain environments, through a SmartWatch device and dedicated App and Cloud services.

The project aims at both providing the user with up-to date information related to mountain activity and collecting data to study hiker behaviours.

The ultimate goal of the project is to increase the number of people capable of safely walking in mountain environment as part of normal fitness activity, with maximum reduction in safety risk arising from the lack of local information.

The user-side of the system will be composed by an Android based SmartWatch able to provide, through a specifically designed App, discreet and exhaustive information including availability in the area, and characteristic of mountain paths, trail length and expected travel time and physical exertion, presence of water point and shelter, and up-to-date information on local weather.

The overall goal is to help the users to choose the most suitable path according to their fitness status and hiking skills and to enjoy in full safety the mountain activity. The system will be able to process data coming from internal or external sensors, such as accelerometers, gyroscopes, magnetometers, heart rate sensors, GPS, that will be used to display and log journey information and user status. The system aims moreover to collect data form the user to create a database and statistical models to identify typical behaviour during trekking activity. The data could be processed to recognize dangerous situations and may suggest action in order to further improve safety during mountain activities.

Si14 "WearIT" smartwatch, which will be the enabling technology for the sHike Project

Description

The sHike project aims to develop an application based on a cloud platform with two parallel objectives:

    a. To provide users with information about the mountain path, length and travel time, historical and / or natural information, weather information, about the opening of shelters and how to access existing services;

    b. To collect aggregate data on trekker behavior for the study of the physical activity in the mountains as a way to promote health.

Despite the high number of smartphones available in the world (over 1.4 billion in 2013), a large increase in smartwatch devices is anticipated to occur in the next few years.

The opportunity to develop applications designed for these smartwatch devices enable interaction with users in a direct and bidirectional way.

Unfortunately, the current smartphone and smartwatch products currently available in the market do not allow saving sensor data with enough precision and speed to capture and describe the hiker movements; moreover they often have battery duration capabilities not always compatible with mountain activities.

The project will introduce a SmartWatch device dedicated to the sports sector (WearIT) equipped with an Android operating system and the ability to connect to different sensors.

The system consists of an App and a Cloud service to collect data from different sensors, such as accelerometers, gyroscopes, magnetometers, heart rate sensors, GPS. All these data will be processed by a dedicated coprocessor and the App to provide real-time information to the user, and will be collected by a Cloud service to create profiling on different user segments. The device will then conjugate the flexibility of an Android device with a dedicated sport oriented coprocessor that extends battery duration and high speed sensor acquisition.

It is required to develop an application that, using the cited features on a Smartwatch and a Cloud platform, provides helpful real-time information to hiking users in mountain areas.

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Reference scenario

Referring to the mountain tourism in Italy (source: ISNART Unioncamere – Mountain Tourism Report, Jan 2012), the yearly arrivals in mountain resorts exceed 10 million. Of those, 39.1% intend to spend a sport-oriented holiday. Once in place, 82.9% of all tourists practice some sports and 39.2% of them take part in excursions to parks and natural areas. Nevertheless, many people (69.9%) do not search for the relevant trail information before starting their walk or hike.

Exposing to the mountain environment without adequate preparation, as well as allowing fears or concerns to reduce potential tourist attraction, is one of the major causes of difficulties as mentioned by the annual report of the "Italian Alpine Rescue", where 26.1% of the interventions arises from superficial approaches to the mountain (incapacity, loss of orientation, delay, exhaustion).

The information delivered through sHike, in a discreet and exhaustive way, may lead the users to choose the most suitable path according to their fitness status and technical skill and to enjoy in full safety the potential of landscapes, nature and culture of the place.

For this reason, making a database of routes and natural/historical information and their descriptions is not enough: this must be supported by a proper exercise prescription according to the characteristics of the user, its capabilities and environmental conditions.

Physical exercise in the mountains, in particular walking, meets very well the prescriptions of the ACSM / AHA about exercise and health. Indeed, the two main suggestions given, that is, moderate and vigorous-intensity aerobic activity and muscle-strength training (Haskell et al., 2007), can be met by uphill and downhill walking in mountain paths. These indications are supported by the possibility to perform physical activity in a pleasant and stimulating environment, often in the company of other interested individuals.

Si14 ("*il proponente*"), in collaboration with partner research centers, aims to achieve an integrated platform comprised of a social network and app, especially developed for the WearIT smartwatch and smartphone, so as to promote physical activity in the mountains, and to facilitate maximum enjoyment of the environment, with maximum safety.

The availability of a large amount of data acquired by the Cloud allows studying the range of physical activity performed by mountain hikers. Data such as the characteristics of the users, their level of fitness, the trails selected, the travel time, the perception of fatigue may be usefully collected for a large number of people.

The physical exertion during mountain activity will be calculated by developing specific algorithms for energy consumption estimation on each specific path according to their difficulty level. This estimation could be individualizes and provided in real time by the use of the device sensors.

An important aspect on safety during physical activity in the mountains is the meteorological

condition. To this end, the system will be able to provide the weather information automatically taken from regional weather centers presenting them with a common graphic layout.

The availability of accurate and correct information will be a focal point of the project.

To this end, effort will be devoted to automatically collecting different data (tourism office, shelters, transport services, weather forecast, etc.).

These information may be sent to the application from the Cloud in order to allow the user to access it in an easy and intuitive mode.

The system aims to create a database and statistical models to represent and identify useful trigger events and to recognize the effectiveness and quality of the trekking action, recognize dangerous situations in order to obtain information about the state of health and the position of the people.

The data acquired by the platform may also be useful to partner as, for example, the state of conservation and the difficulty perceived in the different trails evaluated by the users will be provided to the CAI.

The opportunity to use the system in city environment, although initially with less information, may be useful to monitoring motor activity once the user (tourist) back into the urban environment giving him feedback to encourage the maintenance of walking activity according to the guidelines of the World Health Organization (WHO).

Project Goal

The Applicant team should design, develop and test a WearIT smartwatch App capable of providing a Smart Hiking experience, and resolving the problems described for the considered scenario, by supplying macro features including:

- hiking track pre-selection on the watch before starting the hiking experience
- hiker data acquisition during the hike
- reporting Points of Interest during the hike
- helping the hikers find shelters or food during the hike
- reporting weather conditions during the hike
- mapping & navigating during the hike
- showing statistics and meaningful information during the hike
- keeping the hiker in contact with local authorities or emergency numbers, syncing data with the WearIT Cloud at the end of the experience.

The detailed requirements for the sHike App, the Cloud App, their workflows and GUIs will be agreed between Si14 and the supplier during the early stages of the Project.

The development and delivery of the smartwatch App is mandatory; the development of the full WearIT-Cloud Application is optional (the supplier may choose to develop selected portions of the Cloud Application at their own discretion).

Required deliverables

The following deliverables are expected as the output of the project:

- D1 ("**sHike SmartHiking App**") : WearIT-compatible Android 4.4.2 Application for the WearIT smartwatch. *This is mandatory*.

- D2 ("**sHike SmartHiking Cloud App**") : WearIT-Cloud-compatible Java Application for the WearIT Cloud Portal. *The full Cloud Application is Optional, the Applicant shall choose to develop selected portions of the Cloud Application at own discretion.*

- D3 (optional): Any additional WearIT App.

Source files and documentation

D1 and, if applicable, D3 should be supplied as Android 4.4.2 binary packages ready for installation on a WearIT smartwatch. D2 should be delivered as a running WearIT-Cloud Java module, for installation on the WearIT Cloud Portal.

Source files for both D1 and D2 should be accompanied by full user-manual instructions.

Technology Stack

The Project shall be developed with the following technologies:

- For D1 (sHike SmartHiking App) and possibly D3:
  - Android 4.4.2
  - Extension WearIT API
  - JSON Schema
- For D2 (sHike SmartHiking Cloud Application):
  - JSON Schema
  - The Spring Framework
  - WearIT-Cloud API

Android 4.4.2 and its SDK

Android is the most popular operating system for mobile devices. Based on the Linux kernel and currently developed by Google. With a user interface based on direct manipulation, Android is designed primarily for touchscreen mobile devices such as smartphones and tablet computers, with specialized user interfaces for televisions (Android TV), cars (Android Auto), and wrist watches (Android Wear).

The OS uses touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching, and reverse pinching to manipulate on-screen objects, and a virtual keyboard. Despite being primarily designed for touchscreen input, it also has been used in game consoles, digital cameras, and other electronics.

WearIT uses Android 4.4.2 a release of Android 4.4 "KitKat" family.

WearIT Android 4.4.2 comes with a set of extensions specifically developed for the WearIT smartwatch – such extensions come with a documented set of APIs (WearIT API).

Developing Apps for the WearIT smartwatch is very easy thanks to the Android SDK.

The Android software development kit (SDK) includes a comprehensive set of development tools. These include a debugger, libraries, a handset emulator based on QEMU, documentation, sample code, and tutorials. Currently supported development platforms include computers running Linux (any modern desktop Linux distribution), Mac OS X 10.5.8 or later, and Windows XP or later. For the moment one can also develop Android software on Android itself by using the AIDE - Android IDE - Java, C++ app and the Java editor app. The officially supported integrated development

environment (IDE) is Eclipse using the Android Development Tools (ADT) Plugin.

JSON-Schema

JSON-Schema is an intuitive, clear, machine and human readable format to help building complex structures of data and validate JSON data exchanged between peers on the network.

JSON, or JavaScript Object Notation, is an open standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs. It is used primarily to transmit data between a server and web application, as an alternative to XML.

Although originally derived from the JavaScript scripting language, JSON is a language-independent data format. Code for parsing and generating JSON data is readily available in a large variety of programming languages.

WearIT uses JSON to perform data exchange between the WearIT devices and the WearIT Cloud server.

For more information refer to http://json-schema.org/.

The Spring Framework

The Spring Framework is an open source application framework and inversion of control container for the Java platform. The framework's core features can be used by any Java application, but there are extensions for building web applications on top of the Java EE platform.

Although the framework does not impose any specific programming model, it has become popular in the Java community as an alternative to, replacement for, or even addition to the Enterprise JavaBean (EJB) model.

The WearIT Cloud server uses Java and the Spring Framework as its main development and deployment framework.

The WearIT Cloud API

The WearIT Cloud API are a set of specifications and software modules dealing with the WearIT specific cloud modules running on the WearIT Cloud Servers.

The API allows developers to interact with the WearIT Cloud functions, enabling the creation of WearIT Web Applications.

Supplied technologies and tools

At Project start-up, the Applicant will receive the following tools from Si14:

- Fully functional WearIT Engineering Prototype
- Android 4.4.2 SDK with modifications for the WearIT Device
- "Developer Walkthrough" Manual
- Android 4.4.2 WearIT Extension API Documentation
- WearIT Cloud API Documentation

The "Developer Walkthrough" will be supplied with the prototype and SDK, in order to help you getting familiar with the WearIT SDK and Device. The Developer Walkthrough will guide you in:

- Presenting the WearIT smartwatch device
- Setting up the device and start using it
- Setting up the development environment and all compiling and installation tools
- Understanding the basic functionalities of the WearIT device and Cloud, including the WearIT-specific Cloud and Data Synchronization mechanisms
- Understanding the example JSON Schema

The Developer Walkthrough will contain a set of examples in order to get you up and developing in a matter of minutes.

The Applicant will also receive a flowchart of the SmartHiking App to be developed. Such a functional flowchart will guide the proponents in designing the App, the GUI and the interactions with the user.

Development Ramp-up Support

In order to boost development and accelerate your getting familiar with the WearIT device and development tools, the WearIT team will assist the proponents in setting up their development environments, setting up the WearIT devices and build the first example applications.

The WearIT team will be available for technical support and help during the full duration of the project.

Device Technical Specifications

- CPU   Cortex A8 600MHz
- RAM   256 MB
- Flash Storage   4 GB
- Display   Color display, 1.54'' 240x240 px
- Connectivity   Wi-Fi 802.11bgn, Bluetooth/BTLE, USB 2.0
- Localization   GPS
- Onboard sensors   Accelerometer, Magnetometer, Pedometer
- Supplied Accessories   Charging Clip / USB Port
- OS   Android 4.4.2

The Android 4.4.2 OS will be provided to the supplier, together with the complete development environment, including all standard Android tools and a WearIT simulator.

Change Request Management

The parties may propose changes to specific requirements by submitting a formal "Change Request" to the other peer.

The Change Request shall include the old text to be modified (if any) and the proposed modification, together with the reason for change.

The Change Request will become "Accepted" only if both peers agree on the Change. In that case, the relevant documents will be amended accordingly. Otherwise, development will continue in accord with the latest agreed baseline.

Project Management

Both parties will name a "Project Manager" to act as the main interface between the parties.

The supplier shall interface to the customer solely via the respective Project Managers.

Any direct technical communication between members of the two parties, who are not Project Managers, shall include both Project Managers in copy.

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Ownership

The property of all the documents, including the developed source code, will be shared by Si14 and the supplier. The parties will negotiate the use of the developed code to allow further evolution of it by Si14 outside of this project.

Warranty

The supplier shall resolve bugs reported by Si14 during the full duration of the project, that is, until final customer acceptance of the product. Si14 will report bugs found on the code via an agreed web-based collaborative tool such as Redmine.

NDA

Owing to pre-existing restrictions and industrial rights on the WearIT device, all members of the supplier team shall sign an NDA (Non-Disclosure Agreement) with Si14 and shall not divulge information on the WearIT device, API and Documentation until the public release of the WearIT device will have occurred.

About Si14

Si14 is was founded in 2008 by a team of young professionals with a deep experience in board system design.

Si14 provides consulting services on new design applications and product realization for its customers.

Broad in approach to delivering new technology, Si14 is specialized in miniaturization of systems based on Android, cloud computing and wearable monitoring devices with the introduction of the first Android – Cloud based smart watch.

Document Control Register

This document is currently final, ready for public release.

Latest revision 20141026 by Fabio d'Alessi (Si14 SpA).