

# An Integrated Demo of the Digital Assistance Services in Emergency Situations Based on Smart-M3 Technology

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**Abstract**—In the proposed demo, the system intended for providing a set of assistance services for people in emergencies, bystanders and caregivers is presented. The system is organized as the number of distributed data providers and consumers written in Smart-M3 paradigm and operating on mobile devices, workstations, or in the cloud. We generalize the experience of distributed development of the system components and provide the overall evaluation from the point of view of feasibility and benefits of the approach.

## I. INTRODUCTION

Medical emergencies may have long-term implications on the quality of life of the patient or even on the survival. Reducing negative influence on the patient's condition is caused by emergency response time decreasing and by the improvement of first aid quality that may be achieved using the personalized treatment.

Digital assistance service is designed to improve efficiency in the ambulance or first (pre-medical) care delivery. It is effective in case of emergency, including life-threatening situations, such as a sharp deterioration due to the complications of chronic cardiovascular diseases.

Increasing the effectiveness of aid is provided by the design of new services for geographically distributed participants of the system. Various groups of individuals may be under the supervision. Healthy people may be worried about high risk of the emergence and the disease development due to individual predisposition. They are monitored for disease prevention and assessment of risks of complications. Clinics patients are monitored to prevent the development of sudden complications with chronic diseases. For the prevention of emergency conditions athletes are monitoring because of high physical overload. People can provide themselves as a volunteers willing to offer the first aid. This can be relative of observed person, ambulance staff, clinics staff, trained volunteer, etc.

## II. ASSISTANCE SCENARIOS AND SERVICES

The service may be successfully implemented with the idea of IoT and smart spaces approach. The concept was researched and proposed in [1]. In [2] typical use case of communication between emergency medical services equipped with the "panic button" and healthcare information systems are identified, and analysed of possible ways of organization

of such a communication. Presented approach formed the basis of the service architecture. Digital assistance service represented by a set of software agents: the agent access to the medical information system, the patient's agent, volunteer's agent, dispatching agent. Digital assistance service architecture is shown in Fig. 1. Implemented services are designed on the basis of information sharing in the general smart space.

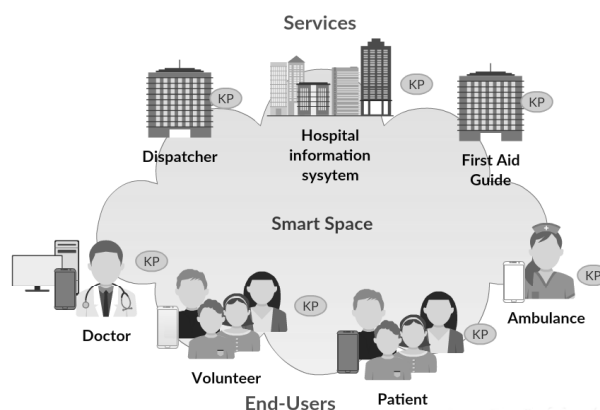


Fig. 1. Architecture of digital assistance services in emergency situations

Patient's agent provides a collection of digital recordings of biosignals and their primary processing. Agent conducts periodic audits of the patient's health through questionnaires. It collects complaints due to the sharp deterioration in health status when patient send an alarm notification. Agent provides an extract from the intellectual space formed by the recommendations related to the adoption of urgent measures. Agent facilitates planning visits to the doctor.

The first aid guide kp provides the questionnaires. It includes questions that help determine the health status of the patient. Questions can be formulated in various ways. Open-ended questions require an answer records in free text form. Half-closed questions make it possible data validation. Close-ended question requires to choose the correct answer from the proposed or estimated parameters, characteristics, properties. Patient's agent provides the ability to conduct surveys on the health status of the patient and the publication of the answers in the smart space.

The patient is authorized on the server with a mobile application. Emergency assistance request becomes available. When a request is sent, it is possible to fill in the questionnaire and clarify emergency symptoms. The patient will be able to fill out a regular survey of health. If the patient forgets to pass it within a week, the application will remind to do it.

Patient's mobile application has the ability to connect to a digital device for collecting biosignals. The data may be collected from big variety of such sensors [3].

Volunteer agent provides a collection of information about the patient obtained during visual inspection. Volunteer also authenticated to the server via his mobile application. He presents the status of readiness to help. If he is ready to help, dispatching agent sends requests for assistance. When volunteer confirm the patients request, the application displays the patient location and the route to him.

Patient and volunteer agents are implemented in the respective mobile applications for Android. Patients and volunteers agents support users location data in actual state in smart spaces.

HIS Agent provides the services to extract documents from the electronic medical patient card that contains all the history of interaction between the patients and the medical facilities. It includes documents on doctor's medical examination, demographic data, a set of measurements performed by the patient and laboratory analysis results. All other agents may request a subset of those documents from the HIS Agent via the smart space. The request may filter documents by the submission date, document type and contents of the document. Every document contain a set of fields that correspond to the type, but it is not required for them to be fully filled.

Dispatching agent [4] performs the distribution of volunteers to provide first aid in case of an emergency situation, using the patient's health parameters saved in smart spaces. Dispatching Agent connects data about the patients and volunteers location for the optimal distribution of emergency requests from patients among the volunteers. Agent takes into account the individual differences of patient. Agent analyses the operative health information and data from electronic medical patients card.

### III. DEMO OPERATION

The demo plays the situation when a patient feels bad and needs medical help. In this case he may send panic signals using the mobile application, as it is shown in Fig. 2. When dispatching agent send notification to nearest volunteer, user the similar mobile application, volunteer will come to help, as it is shown in Fig. 3. He may accept help request or reject it. In case of a positive answer, a route from patient to volunteer is built.

During the demo the HIS Agent will record all the request that were made. The record will contain not only the parameters of the request, but also the set of documents that were retrieved during the operation. The log allows to see the operation between the agents during the provision of the first aid.

The HIS Agent also provides a web-interface that allows to browse documents in the storage. The web-interface provides

the same functionality as the smart space interface, it allows the user to browse the list of patients and make requests for documents of the particular patient. Then user is able to see the contents of the documents that were requested by the user.

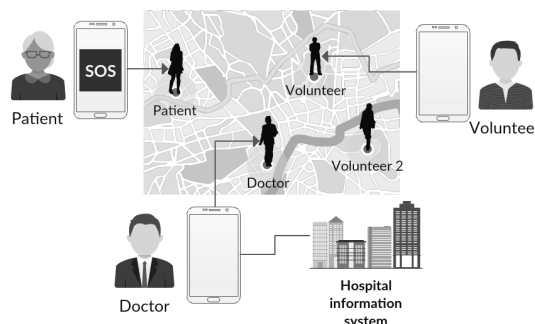


Fig. 2. First aid scenario: panic button

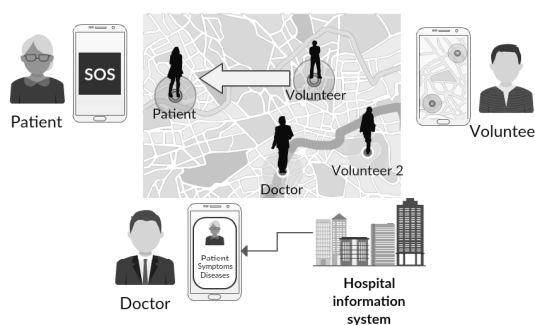


Fig. 3. First aid scenario: HIS answer

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