A Social Network Framework for the Carolina Software

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ABSTRACT
The study of medical protocols for monitoring and analyzing the cognitive development of children with disabilities is a fundamental research area. In this context, a well-established curriculum-based assessment is the Carolina Curriculum for Infants and Toddlers with Special Needs (CCITSN). In a recent paper, Cuomo, Murano, and Piccialli introduced the Software client-server software Carolina to carry out all features of CCITSN. Critically, CCITSN does not allow to share and to exchange the experiences between all actors enrolled in a long time Curriculum program. In this paper we address this problem by extending the Carolina software by means of an highly innovative communication social networking framework, built ad-hoc.

Categories and Subject Descriptors
J.3 [Medical information systems]:

General Terms
Social Networking, Assessments programs, Carolina Curriculum, Design, Experimentation.

1. INTRODUCTION
The study of medical protocols for monitoring and analyzing the cognitive development of children with disabilities is a very spread out research area (c.f., [3]). Many studies in this field are based on means-end behavior, which involves a painful execution of a sequence of steps to achieve a goal and occurs in situations where an obstacle preventing achievement of the goal must initially be removed [1, 6]. In this context, the Carolina Curriculum for Infants and Toddlers with Special Needs (CCITSN) [4] is a well-established curriculum-based assessment that provides intervention strategies appropriate for young children with disabilities. The advantages of the Carolina Curriculum are intrinsically clear and well established (see [5]). Recently, in Italy the Carolina Curriculum has been adopted as a basic service within several local Regional Service Systems (ASL).

A full web application software system, named Carolina, based on the Carolina Curriculum protocol is available in [7]. This software allows, from one side, to efficiently collect, represent, and evaluate the relative data along the curriculum and, from the other side, to support educators, doctors, parents, volunteers, therapists, and the children themselves in the assessment-intervention process of the children involved, all as required by the Carolina Curriculum. The Carolina software allows all medical operators involved in the children development skills process to have a concurrent and real-time access to all data, with respect to their own access privileges, and to add, modify, elaborate, and organize them.

Unfortunately, the Carolina protocol, and so the software developed in [7], takes care only of the medical aspects, which are basically recorded with a huge gap of time intervals. Indeed, the medical operator records patient assessments at intervals of 6 months. Moreover, families and children cannot communicate actively with the software. So, they cannot ask questions and post experiences on the software. Most important, as the protocol is mainly based on the observation of the abilities performed daily on specific exercises and duties assigned to the children, the missing of the interaction makes the use of the Carolina program less useful in practice.

To address this problem, we consider the applications, services and tools that are Web-based services for health care consumers, caregivers, patients, health professionals, and biomedical researchers. We propose all these features that use Web 2.0 technologies and/or semantic web and virtual-reality tools to enable and facilitate specifically social networking, participation, communication, collaboration, and openness within and between these user groups. Social networking service embedded in the Carolina software is a solution in our case. It involves the explicit modeling of connections between people, forming a network of relations, which in turn enables and facilitates collaboration and collaborative filtering processes. In the proposed framework, this service enables the families enrolled in the Curriculum to ask...
assistance to medical operator by means of messages, web conference, ecc.; enables to see what their peers or others with a predefined relationship ("families friend", "doctor", "assistant operator", etc.) are doing in the same assessment; enables to have supplementary medical advices on demand. The Carolina Social network service give also an automated selection of "relevant" information, based on what peers are doing and reading on the Web.

2. CAROLINA SOCIAL NETWORKING

The proposed framework implements an architecture for enabling a social networking healthcare platform, offering tailored medical services in a familiar and friendly way. In the Carolina Curriculum an interaction between the families and the medical operator is represented by an "ad hoc" planning program automatically generated by the software. The overall information obtained by the Carolina Curriculum therapy are elaborated by different software modules and for each patient the results of planning program is reported in a Develop Progress Diagram (DPD) as showed in figure 1.

![Figure 1: a Develop Progress Diagram (DPD). Blank cells correspond to score 0, red cells correspond to score 1, the remaining ones to score 0.5. By means DPD the operator at a glance can immediately observe the children skills status. This is too restricted approach respect to the assistance due to the actors of this protocol. Taking some of the terminology from Carolina Curriculum and mapping them to social networking, we define the following terms:

- Carolina Assessment Group: A group within a buddy-list comprising of health-care professionals and the patients they are treating.
- Carolina Medical Group: A group within a buddy-list comprising of health-care professionals only.
- Families Context: A group of families enrolled in the Curriculum.
- Supplementary service: Experts that sit in the care groups offering predefined services to the users of the group.
- Social Networking Services: Instant Messaging (IM), Web Conferences, Posted Messages, Wiki, etc.

The following is an experimented scenario that shows the integration of social networking terms into the work of the Carolina community. A medical operator and his collaborators are involved in the care of 50 families (with a children in the assessment program). The families are split logically into care groups associated with the age of patients. The patients within a fixed age group have to develop the right skills in accordance to the age. A patient fails to perform some of the tasks assigned to him for the achievement of a certain skill. Consequently, the family decides to post a request for assistance in Carolina Assessment Group and Carolina Medical Group. Subsequently, a member of the Carolina Medical Group decides to activate and schedule on-line assistance service through web conference tool provided by the framework.

In the meanwhile, the community start to answer and post advices on the Group of Families Context, so exploit the services offered by social networking.

The Figure 2 report the idea underling the software implementation. In the center of the Figure we have specific tools and services offered by the innovative communication technologies.

![Figure 2: The Carolina Communication Model]
enables the efficient exchange of experiences and sharing emotional states. Our model is a multidimensional scheme in which we have different levels of interactions. Horizontal interactions between families and patients enrolled in the assessment. Vertical communications between families and medical operators that work with Carolina. Each user group has received a different level of training assessment. Families and patients can be seen as experts and their collective wisdom can and should be used. As affirmed in [2] the health operator is an expert in identifying disease, while the patients and families are experts in experiencing it.

3. THE SOFTWARE ARCHITECTURE
The Carolina framework has been implemented over a three-tier infrastructure, that is a client–server architecture in which the presentation, the application processing, and the data management are logically separate processes. In Figure 3, we report a graphical representation of the software framework. We have chosen to use a multi-tier architecture as it allows us to develop a flexible and reusable application. Indeed, by breaking up the Carolina framework into tiers, future developments of the infrastructure may involve only a specific layer, rather than to rewrite the entire application over. Specifically, the Carolina framework has a client tier, an application tier, and a data tier, working as follows: every single Regional Local Health Department is connected to a Data Center in order to store and manage the data of the medical protocol. In our design, the Data Center is implemented in the Back-end of the Framework.

![Figure 3: The Carolina Framework](image)

More technically, the framework is structured as follows.

- **Client Tier**: This is the topmost level of the application. It is composed of the front-end pages of users (doctors, teachers, patients, families, etc.) and the interfaces they use. These interfaces are split into two main areas. The first one is the Carolina portal that allows all medical operators involved in the children development skill processes to have a concurrent and real-time access to all data, with respect to their own access privileges, and to add, modify, elaborate, and organize them. The second one is the social network that allows all interactions between the actors of the medical assessment, as just described.

- **Application Tier**: This tier is composed of the PHP (version 5) modules and Web 2.0 services implementing the business logic of the application. Most of these modules and services are responsible for processing the user input from the upper tier, as well as for the loading and storing of data in the lower tier. Note that at this level it is hidden the way the storage of data is implemented in the Back-end.

- **Data Tier**: This tier consists of a relational database server, deployed by using MySql as a database management system. Here all information are stored in the Back-end. In particular all relationships between the different domains of Carolina Curriculum, which consist of sequences and items, and tables that define Communication Groups and Context have been implemented. This tier keeps data neutral and independent from the other two tiers.

The application is fully accessible with a web browser. The navigation is facilitated across the simple interfaces based on menus and navigation bars. No browser plug-in installations are needed, except those ones for the Java runtime to run applets. It is worth noting that the system has been tested on recent versions of the most common browsers (i.e., Internet Explorer, Mozilla Firefox and Google Chrome). We now give more details about the storage aspects. The database has the aim of recording for each child, all its evaluation data, elaboration, and in particular the data scores. Also, it offers a useful centralization of data, in such a way that every subject involved in the Carolina Curriculum can easily access to the children information database, according to their access privilege, in order to add, modify or simply watch children data and programs. Finally, the database structure is used to implement the social networking aspects of the Carolina framework. In particular, it takes care of relationship among the people that access to the portal, and as well as the documents their share.

As we have anticipated before, the Carolina portal and the Social Network represent the two souls of the framework architecture, working together in a virtuous way. We now give a briefly description of them and their interaction. The Carolina portal allows to access easily to clear tables and charts to fully understand the development level reached by children, as well as the program they have been following since their enrollment under the Carolina Curriculum. In Figure 4, we show the Data Report Panel that reports by means of tables and development progress charts, the following information: development age, development rate, and particularly the data scores.
implemented. The ERP is composed of eight panels, which allow to make, in a sequential way, the following main tasks required by the Carolina Curriculum: preliminary evaluation, data store, data analysis, program plan.

In the social networking service, a user-friendly graphic interface (see Figure 5), allows the operators and families to easily share data among them, have detailed information about scores and items of the curriculum, monitor skill developments along the time by means of system communication. In particular, the doctors can share data and experiences to improve the treatments on the children, such as the Caroline Medical Groups. Moreover, patients and their families can share medical data as well as personal experience and troubles, which turn to be helpful both in the medical and emotional sides. All these features guarantee that every child will has a full assistance, corresponding to his specific needs.

4. CONCLUSIONS

In this paper, we present a software framework for the CC-ITSN medical protocol, which extends the Carolina software implemented in [7], by means of an highly innovative communication social networking framework, built ad-hoc. In addition to the previous software version, the new portal allows us the full and continuous communication and sharing of informations between all actors enrolled in the curriculum, in a virtuous way. As a key aspect of this work, we want to enlighten the proposed innovative communication model, which we believe is also important as its own and can be fruitfully applied to other e-health-care scenarios.

5. REFERENCES