

SFML: Screening Form Markup Language for Healthcare Service

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Abstract— This paper proposes a markup language to describe and deliver the contents of health screening form. In this paper, we define elements and schema needed to generate a health screening form based on personal lifelogs including data from a daily domain, a health domain and a medical domain. In our proposal, we allow for three categories of data. First, the daily domain includes lifestyle data represented as activity, a sleeping pattern and eating habits. Second, the health domain includes height, weight, blood pressure, glucose and so on. Third, the medical domain includes the result of medical treatment information from a medical institute. This information is structured as SFML and can be exchanged with participant of health service entities.

Keywords— Screening form, markup language, lifelog, healthcare

I. INTRODUCTION

Screening, in medicine, is a strategy used in a population to detect a disease in individual without signs or symptoms of that disease. Unlike what generally happens in medicine, screening tests are performed on persons without any clinical sign or disease [1].

Today, almost all the people have chance of a regular health screening supported by a company or the government every year. As preparing the checkup, people may generally fill up the health screening questionnaire to describe their health-related condition. From the point of personal information, an individual's lifelog of everyday life is a good record of behavior. Therefore, using the personal lifelogs is good approach to provide personalized healthcare service after the analysis of individual's behavior.

In addition to individual's behavior, we can consider health-oriented information to configure screening questionnaire. As one solution to describe individual's condition and current status of body, we describe a health screening form leveraging

personal lifestyles, biometric information, and medical treatments. By the health screening form, individual's health-related data can be commonly utilized in private and public medical institutes. To this end, users can generate and leverage their screening form. As the result, users can provide their screening form with medical staff on demand when they visit a medical center.

On the other hand, the health screening form is melting pot of various personal data and maybe used various entities of healthcare service. Therefore, we also consider the cooperation and compatibility of them. To meet this need, we propose SFML (screening form markup language) to embrace various data and to exchange them with associated entities.

In this work, we define and specify elements and in/out link of data for personal lifelog-based screening form as part of screening system architecture.

The remainder of this paper is organized as follows. In section II, we present related background environment of this work. Section III shows health screening form. In section IV, we present SFML scheme and the data link model using SFML. Finally, we conclude this paper in Section V.

II. BACKGROUND

This section presents the background environment of this work.

In the medical field, it is necessary to gather as much personal information as possible about patients in order to achieve high-quality diagnosis and treatment. Until now, the personal information used in diagnosis and treatment has basically been

gathered and used only within medical facilities. It consists of clinical records, test results, medical images, and other such information. However, the medical information that can be gathered within a medical facility is very limited. It would seem that there is a large amount of data that would be useful for medical purposes within the voluminous and varied data gathered in daily life, most of which is spent outside medical facilities, but such lifelog data has gone unused in most cases [2].

In Korea, SBI (systems biomedical informatics) research center aims to create personalized ‘health avatar’, representing individuals genomic through phenomic reality (or ‘digital self’) using multi-scale modeling and data driven semantics for the purpose of personalizing healthcare [3].

‘The health avatar platform’ will be created as an agent space and health data integration pipeline. ‘Health avatar platform’ will create a space for interacting plug-in intelligent health agents and data analysis toolkits and provide a data and access grid for heterogeneous clinical and genomic data. The health avatar platform will function as an infrastructure for the development and evaluation of intelligent health applications for personalized medicine.

Figure 1 shows the conceptual diagram of health avatar and this work is conjunction with the ‘Connected Self’ of health avatar project supporting lifelogs and stream-type data mining for health protection.

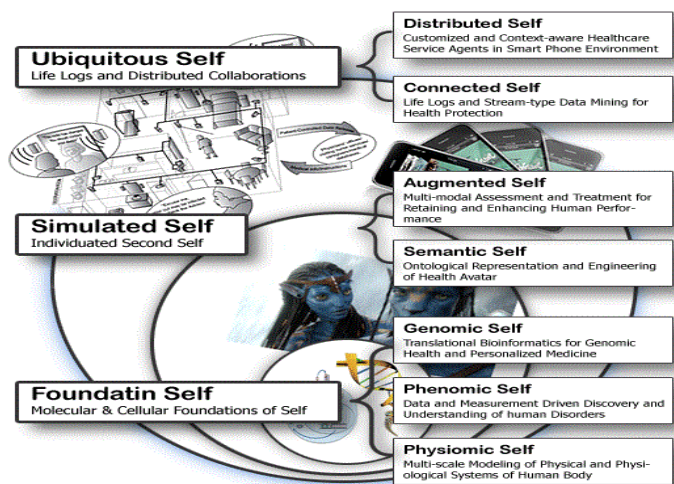


Figure 1. Conceptual diagram of health avatar

III. HEALTH SCREENING FORM

Basically, the health screening form should reflect individual’s lifestyles, health-related information and medical treatments. And it is also compatible with a conventional paper-based screening questionnaire.

In order to satisfy these requirements, we can summarize components of the health screening form as three categories of data as followings:

- Lifestyle logs: representing user’s lifestyles such as activity, sleeping patterns, and eating habits
- Health logs: representing biometric information of individuals such as height, weight, blood pressure, heart rate, blood glucose, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides and so on
- Medical logs: representing medical treatments such as genetic disease history, previous drug reaction and so on.

Additionally, we can also consider interactive question & answer tool [4] on behalf of paper-based screening questionnaire.

Figure 2 shows the conceptual model of a health screening form and operational flow.

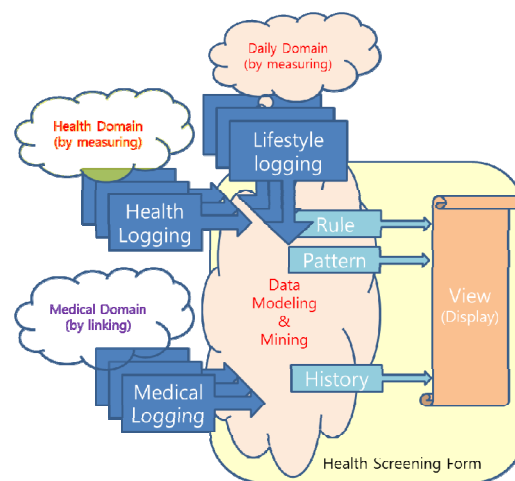


Figure 2. Basic concept of a health screening form and its operational flow

Basically, the health screening form consists of data of daily, health and medical domain. Then, these data are mixed and mined with knowledge

from various expertises. From these processing, we can summarize the user's lifelogs as 'rule', 'pattern', and 'history'. These elaborated data can be seen to user through a smart device and transferred to a care giver for an advanced care.

As data items for generating screening form considered in daily domain, we can leverage data such as activity, sleeping pattern, and eating habits associated with lifestyle. The data associated with lifestyle in daily domain can be collected by wearable or portable life logging device or a smartphone embedding various sensors. The following descriptor, lifelog descriptor, shows the example of lifestyle data structured by XML.

```
<?xml version="1.0"?>
<lifestylelog name="Lifestylelog" Descriptor"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://www.etri.re.kr/ncrc/connectedse
lf/lifestylelog.xsd">
  <log_info>
    <owner name="Gildong Hong"/>
    <id>gd_hong</id>
    <device>
      <description>smart phone lifestylelog collector</description>
      <identifier>kr.re.etri.ncrc.lifestylelogger.type1</identifier>
      <vendor>ETRI</vendor>
      <model_number>2000-1000</model_number>
      <model_info>http://www.etri.re.kr/ncrc/lifestylelogger/2000-
1000</model_info>
    </device>
  </log_info>
  <items>
    <item data="sleeping">
      <!--for readability. actually, millisecond from 1970 is used in practical
case-->
      <start_time>2011.11.22:23:00:00</start_time>
      <end_time>2011.11.23:07:00:00</end_time>
    </item>
    <!--for readability, actually, the type is coded as byte, for example,
breakfast=1, lunch=2-->
    <item data="meal" type="lunch">
      <menu>Chinese Noodle</menu>
      <!--for readability. actually, millisecond from 1970 is used in practical
case-->
      <start_time>2011.11.22:12:00:00</start_time>
      <end_time>2011.11.22:12:45:00</end_time>
      <base_calorie>1200</base_calorie>
      <!--represented as millisecond for start_time-->
      <photo>13098896899.jpg</photo>
    </item>
  </items>
</lifestylelog>
```

As data items for generating screening form considered in health domain, we can leverage data generally used in home healthcare or mobile healthcare that gathers data from a dedicated device for health information. In general, the device collects data associated with user's biometric

information such as height, weight, blood pressure, glucose, heart rate and so on. The following descriptor, healthlog descriptor, shows the example of biometric data structured by XML.

```
<?xml version="1.0"?>
<healthlog name="Healthlog" Descriptor"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://www.etri.re.kr/ncrc/connectedse
lf/healthlog.xsd">
  <log_info>
    <owner name="Gildong Hong"/>
    <id>gd_hong</id>
    <device>
      <description>wearable bio-signal collector</description>
      <identifier>kr.re.etri.ncrc.healthlogger.type1</identifier>
      <vendor>ETRI</vendor>
      <model_number>1000-2000</model_number>
      <model_info>http://www.etri.re.kr/ncrc/healthlogger/1000-
2000</model_info>
    </device>
  </log_info>
  <items>
    <item data="blood_pressure">
      <!--for readability. actually, millisecond from 1970 is used in practical
case-->
      <value time="2011.11.22:13:00:00" option="min">80</value>
      <value time="2011.11.22:13:00:00" option="max">120</value>
    </item>
    <item data="heart_rate">
      <!--for readability. actually, millisecond from 1970 is used in practical
case-->
      <value date="2011.11.22:13:00:00">80</value>
    </item>
  </items>
</healthlog>
```

As data items for generating screening form considered in medical domain, we can leverage data generated by medical institute such as disease history, genetic disease history, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and so on. The data associated with medical information can be collected by a user so that this information should be linked with the database of medical institute.

IV. SFML: SCREENING FORM MARKUP LANGUAGE

This section describes SFML (screening form markup language) defining 'action' and 'data' elements and in/out data link model.

The items that comprise a health screening form have a hierarchical structure. The top layer consists of 'action' element and 'data' element. The 'action' element defines control messages including 'request' element and 'response' element. The 'data' element defines three categories of items such as 'lifestylelog', 'healthlog' and 'medicallog'.

Each category item has its own sub-items. Each item is represented by XML tags and includes formatted data respectively.

A. Action and Data elements

Figure 3 describes XML tree architecture, named as SFML, including ‘action’ and ‘data’ elements.

The root element is ‘sfml’ representing ‘screening form markup language’. The root element has ‘action’ element for control message and ‘data’ element for data presentation. As sub-element, ‘data’ element has ‘items’ element that has three ‘category’ properties such as ‘lifestylelog’, ‘healthlog’, and ‘medicallog’.

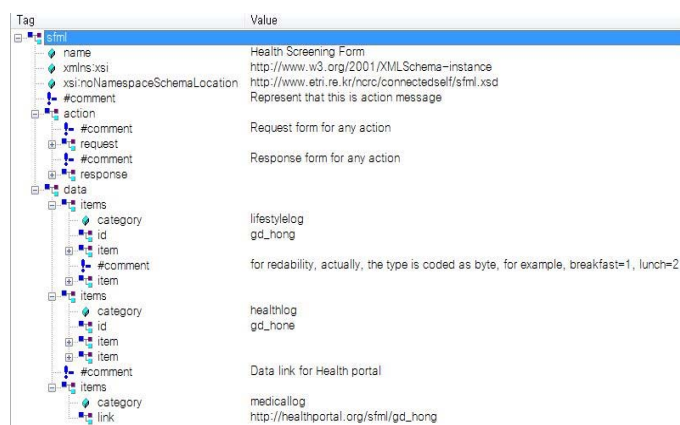


Figure 3. Tree architecture of SFML

Figure 4 and 5 show the ‘action’ element and ‘data’ element of SFML in detail.

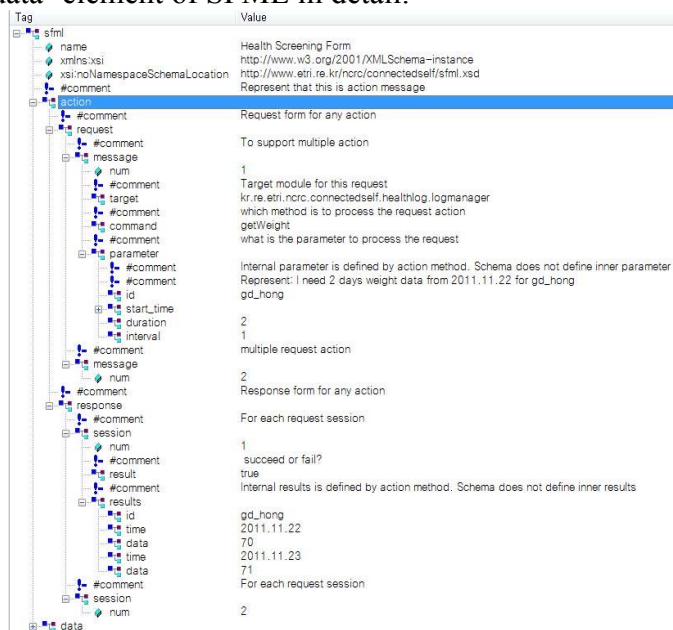


Figure 4. Tree architecture of ‘action’ element

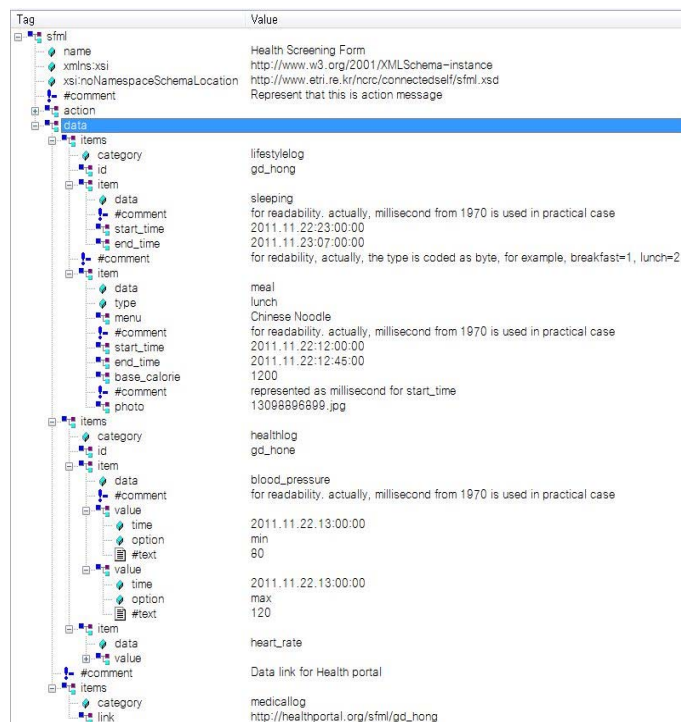


Figure 5. Tree architecture of ‘data’ element

B. Data Link Model

We consider data links from data sources to screening form generator which is functional module of health screening form.

Firstly, the data element for daily or health domain should be encapsulated and transmitted with ‘lifelog descriptor’ or ‘healthlog descriptor’ described in previous section.

Figure 6 and 7 shows data link model for daily or health domain.

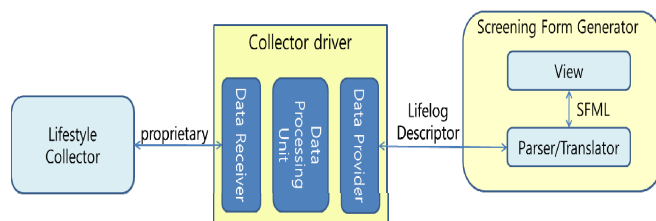


Figure 6. Data link model for daily domain

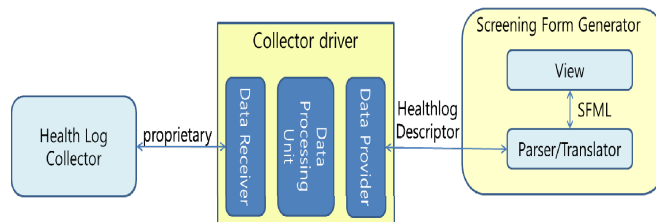


Figure 7. Data link model for health domain

In order to define the data sets for transferring medical treatment documents, we can use CDA (Clinical Document Architecture) [5] of HL7 (Health Level Seven), CCR (Continuity of Care Record) [6] of ASTM (American Society of Testing and Materials), or CCD (Continuity of Care Document) [7] that is combined model of CDA and CCR.

As the data link specification in health screening form, we can use those international standards. Therefore, we just parse and translate the data that is encapsulated with standardized XML format instead of defining new ‘medical descriptor’, described in figure 8.

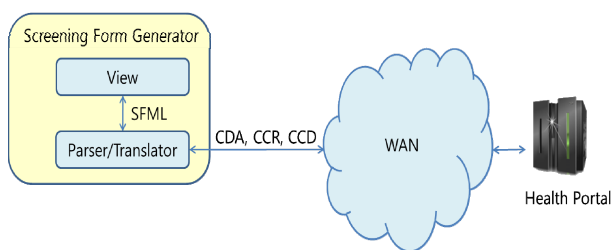


Figure 8. Data link model for medical domain

In the result, data structured by SFML can be exchanged and transferred to SFML viewer of a care giver for an advanced care.

V. CONCLUSIONS

This paper proposes a markup language to describe and deliver the contents of health screening form. In this paper, we define elements and schema needed to generate health screening

form based on personal lifelogs including data from daily, health and medical domain.

Because this work is an initial phase to make a health screening form, we lack of an elaborate algorithm or a breakthrough idea. However, we think this work will contribute to make a personalized and mobilized health screening form reflecting personal lifestyles, health information and medical histories.

In the future, we plan to continue our research efforts in this field with the aim of making an intelligent screening form. So we need to allow for an interpretation of relationship between data by means of data mining algorithm.

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