Project Proposal

Smart Personal Health Record for Pregnancy

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Motivation and Background

Personal health record (PHR) is an emerging technology that enables individuals to manage their health data and improve their health care services by sharing these data with for managing health care providers and help make informed decisions about their own health [1]. PHR is owned and managed by the patient while Electronic Health Record (EHR) is owned by health care providers and is managed by health care professionals [2]. Advances in wearable technology enable continuous monitoring of vital signs of individual patient. In past, such technologies were expensive and restricted to specialized units at provider sites, such as intensive care units, operating theaters. Rapid advances of information and communication technology (ICT), wearable devices, and device connectivity allows continuous monitoring of vital sings using miniatured devices, such as smart watches and non-invasive or minimally invasive sensors and directing the data streams through mobile devices [3]. Barriers to broad adoption of PHR include technical (accuracy, reliability, and consistency of measurements) [4]; communication and safety (ability to capture, transmit and store the information without malfunctioning, loss or distortion) [5]; security and privacy [6], practical usability for consumers (complexity of the record and terminology, accessibility, physical disability, cognitive disability, low literacy and low health literacy, familiarity and comfort [7]. Mobile cloud computing, advances in eHealth, and intelligent PHR systems [8] offer solutions that are already suitable patients with some conditions and needs, such as asthma, diabetes, fertility, glaucoma, HIV, hyperlipidemia, and hypertension [9]. PHRs for pregnancy are already in use, but they are immature products and none of the PHRs has complete functionality [10]. Furthermore, wearable devices for monitoring vital signs are already in broad use for monitoring women's health [11], fitness [12], and pregnancy [13]. Pregnancy is a very attractive area for developing PHR, particularly those that include data from the wearables and smart devices. Specialized pregnancy health records do exist, such as Queensland Pregnancy Record [14]. For each pregnancy, including pre-pregnancy, monitoring is typically less than one year so data can be accumulated fast. One US study [15] reported that 47% of pregnancies had

at least one of the pre-defined complications, most commonly fetal abnormalities and early or threatened labor. Complications associated with highest cost are multiple gestation, hypertension, and diabetes [15]. Quality of life of many pregnant women can be improved by life style intervention (such as exercise and avoiding harmful substances). Evidence-based prevention of pregnancy complications can be achieved by improving the measurement methods for collecting maternal health data and developing new methods for analysis of these data [16]. We propose the development of a Pregnancy PHR that will combine the content of the existing Queensland Pregnancy Record with data from wearables and smart devices.

Aims and Objectives

This project focusses on applied computer science – we will use computer science techniques and methods to solve a real-life medical informatics problem. The overall aim of this project is the establishment of a prototype basic Pregnancy Personal Health Record (PPHR) that will combine data from Queensland pregnancy record, streaming data from wearables, and data from smart devices. The PPHR prototype will focus on monitoring risk in individual for potential complications and actions for improvement of individual's pregnancy health. The design of the software prototype will be built using software engineering principles. It will be built in a modular fashion and allow for easy addition of new software modules. There are hundreds of pregnancy complications and each of these requires a significant effort to be added to the PPHR. Each pregnancy complication has own set of risk factors, treatments, and types of health data. The basic PPHR will provide the basic extensible framework that will be extended in future to a complete PPHR and will focus on monitoring pregnancy-related diabetes and preeclampsia.

Specific aims:

1. **Data.** Basic PPHR will use Queensland health record as a basis. Data from wearable devices and smart devices that are relevant for monitoring risk of diabetes and preeclampsia will be used
2. **Background knowledge**. Metadata will be developed to assist in raw data collection and preprocessing. Risk factors for diabetes and preeclampsia will be analyzed and included in the software product. In addition to the standard demografic data personal medical history and family history, initial data that will be considered include weight and weight gain (smart scale), heart function, level of activity, blood pressure, and blood glucose.
3. **Database and analysis system.** The software product will have the following elements:
    a. Software (user interface, database, search and reporting component, help pages, visualization module, and basic decision-making component.
4. **Project process.** Project documents will include
    a. Initial project proposal (this document, it will be updated regularly)
    b. Project Charter document
    c. User requirements and project assumptions

d. Project plan
e. Other software engineering related documents
f. Interim reports, and final report
g. Demonstration cases
h. Documentation and presentations as outlined in the handbook

Project Plan

Software development will utilize Spiral Model of software development [17]. The main risk of this project will be the delay in the development and implementation of the PPHR – it will be mitigated through iterative improvement of the software solution, rigorous application of software engineering practices, and implementation of formal methods of managing and monitoring progress using ISO software quality principles 1[8]. The emphasis of this project is the development of robust software prototype that will fulfill functional specifications. The theoretical technological and engineering aspects of the software development will be considered and deployed as a secondary priority in this project. Specific tasks in this project are:

Preparatory and process tasks

1.1 Complete and submit project proposal (this document)
1.2 Prepare Project Charter document
1.3 Clarify user requirements and project assumptions
1.4 Develop project plan
1.5 Develop and implement process monitoring and control plan
1.6 Prepare other software engineering related documents as needed
1.7 Demonstration cases
1.8 Documentation and presentations as outlined in the handbook

Software development

2.1 Develop standardized data format and define metadata
2.2 Collect raw data and transform into standardized format
2.3 Design and implement PPHR framework
2.4 Develop and implement generic software for motoring risks in pregnancy
2.5 Implement module for monitoring diabetes
2.6 Implement module for monitoring preeclampsia
2.7 Integrate system
2.8 Test, correct, and validate software
2.9 Iterate process until acceptance criteria are satisfied

Reporting and publication

3.1 Provide weekly incremental progress reports and short monthly written reports
3.2 Complete and submit interim reports as required
3.3 Develop a plan and schedule for preparing the final report, preliminary and revised
3.4 Prepare and deliver presentation (deadline 24.04.2019)
3.4 Write and submit the final report (deadline 11.04.2019)

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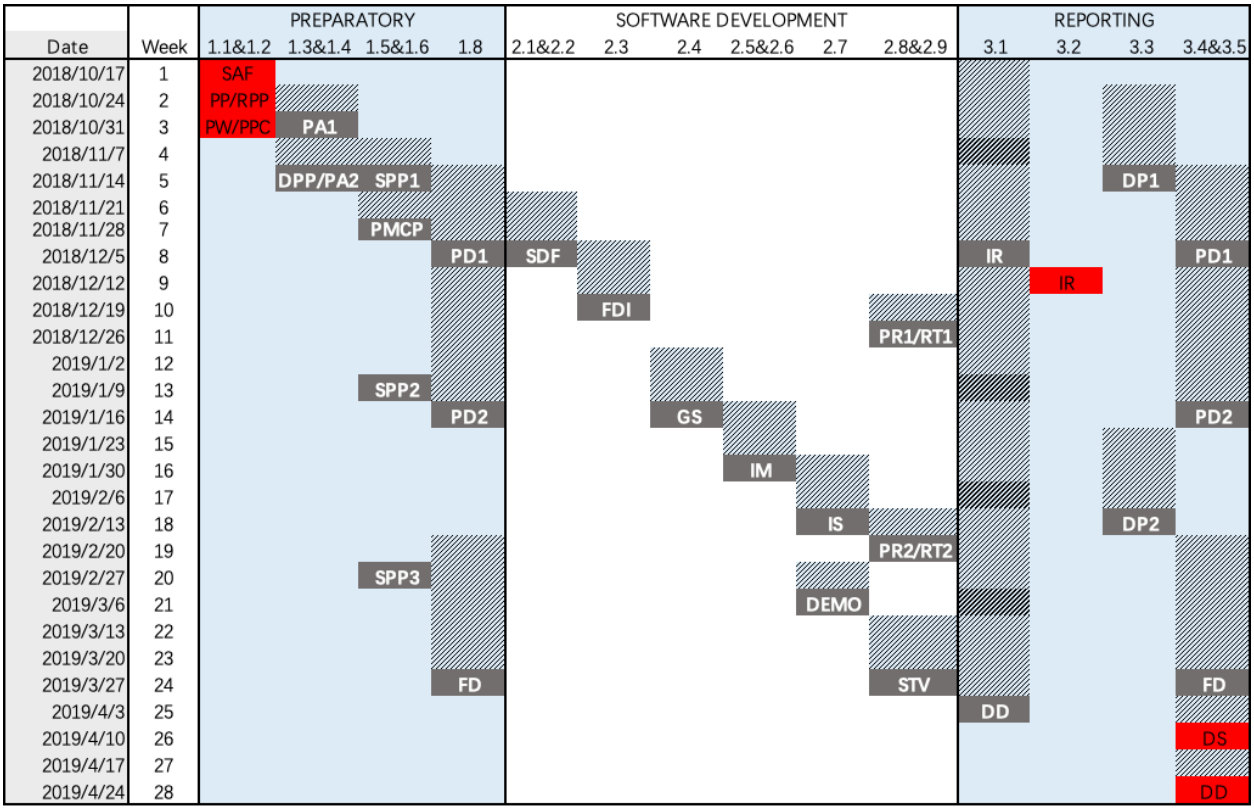
Project schedule and deliverables

This chart is based on the activities detailed in the Project Plan section.



ADMINISTRATIVE DELIVERABLES

2018/10/19	SAF	Supervisor agreement form
2018/10/22	PP	Project proposal
2018/10/24	RPP	Revised project proposal
2018/10/26	PPC	Prepare project charter
2018/10/31	PW	Project website
2018/12/13	IR	Interim report submission
2019/4/11	DS	Dissertation submission
2019/4/24	DD	Demonstration day

INTERIM DELIVERABLES

PA	Project assumption
DPP	Develop project plan
SPP	Software project plan
DP1/2	Dissertation plan and schedule
PMCP	Process monitoring and control plan
PD1/2	Preliminary draft (structure)
SDF	Standardized data format
PD1/2	Preliminary draft (structure)
FDI	Framework design and implementation
PR	Prototype
GS	Generic software
IM	Implement modules
IS	Integrate system
RT	Rapid test
DEMO	Demonstration
FD	First draft
STV	Software development