Rising Orthopedic Problems and Novel Home-Based Antidotes

Kaur Damanpreet*, S. Gowrishankar and Siddaraju

Department of Computer Science and Engineering, Dr. Ambedkar Institute of Technology,
Near Jnana Bharathi Campus, 2nd Stage, Nagarabavi, Bengaluru - 560056, Karnataka, India;
damanpreet121@gmail.com, gowrishankarnath@acm.org, siddaraju.ait@gmail.com

Abstract

Objectives: Today the health problems are increasing at an exponential rate due to our sedentary lifestyle and the nature of job. These problems are of varied nature, viz. respiratory, cardiac, muscular (or bones) etc. In this paper, we are developing an application to provide orthopedic recommendations to the users based on their activity status recorded from wearable device and to prescribe nutritional diet based on the symptoms observed in the people of different age groups. **Statistical Analysis:** Initially the activity status of wearable device users is stored in the android application and then, primary data is collected for the study using semi-structured questionnaire and in-depth interview with the senior orthopedician. **Findings:** We recommend customized novel home-based antidotes as immediate remedies to relieve the peoples' pain. These heath care solutions are provided to the users of the application based either on their observed symptoms or on their age. The orthopedic recommendations are provided in the form of physical activities according to the age of individuals, while dietary solutions are prescribed based upon the user's symptoms. Thus, our application adds value to the existing systems in such a way that it serves dual purposes, viz. general diet recommendations and orthopedic solutions in particular. **Application:** These recommendations, in general are precautionary measures. In future, the application should also cover endocrinal and respiratory disorders and must provide curative measures in the form of first-aid solution for all the covered health problems.

Keywords: Android, Diet, Home-Based, Orthopedic, Wearable

1. Introduction

The global economy has gradually shifted from agriculture to the services sector. This slow and continuous transition brought prosperity to a significant population by improving the quality of their lives, but at the cost of their health. India, being no exception to this reality, also witnessed this health dilapidation on a continuous basis. Our country is primarily dependent on the services sector which has deprived us of the physical activities, unlike in manufacturing and the agricultural based economies, leading to several health problems. These health problems can be of varied nature, viz. cardiac, respiratory, orthopedic etc. Although all kinds of health problems arise at a certain time in middle age, orthopedic problems are more likely to come in young children and/or adults, if attention is not paid to nutrition and physical activity. In other words, it can be said that

the working age population across the globe is more prone to the orthopedic problems. Thus, our country having the highest proportion of the youth people needs an immediate remedy which can monitor their health on a continuous basis and can timely recommend specific health care solution. Here comes the role of the wearable devices which enable the people to track their activity status sitting at home. But after analyzing the health status, home based health care solution is needed to cure or prevent the abnormalities observed in health profile of the user. Thus, this paper not only attempts to apprise the people of orthopedic problems by knowing their physiological parameters and their activity status using wearable device, but also recommends some solutions to the different age groups in the form of diet prescription, physical activity, and sleeping hours, among others.

There is a plethora of wearable devices pertaining to the muscles and bone functioning which play an inevitable

role in detecting limb injuries, muscle deformation, bone abnormalities etc. A general purpose wearable computer is proposed in literature to demonstrate how human perception, cognition, and action work together. The authors propose a human body-and-mind centric design framework and empirically verify the framework by making a wearable personal assistant (WPA) for orthopedic surgeons[1]. Similarly, an android based smart device is developed to help old aged people during medical emergency with the help of internet of things (IoT). This device operates on embedded system platform and can also be employed to alert the user's neighbors in times of distress[2]. Further, an orthotic equipment using shape memory alloy is produced to restore or improve the user's hand functions. The proposed device can also be used on other joints of the human body[3]. Moreover, the mechanical pattern, kinematic matrix, realizable workspace and lively prototype of an upper limb exoskeleton is modelled which intends to recover the people suffering from upper limb injuries, by designing a wearable exoskeleton which provides enough workspace[4]. A virtual rehabilitation center using wearable technology is also developed for those who suffer arthritis[5]. Similarly a tool is proposed to assist medical fraternity in detection, prediction and recuperation of the patients associated with hand movement[6]. Further, a wearable tool called "Hip Guard" is developed particularly for patients undergoing hip replacement surgery to detect the patient's posture and to regulate the weight put on the operated leg[7]. On similar lines, a wearable device based on ultrasonic waves is propounded which regulates and facilitates the recovery process in fractured bones remotely in order to maintain orthopedic health[8].

Wearable devices also find applications in monitoring the diet patterns of the users, which is empirically confirmed by various research studies. A wrist-worn smart watch is proposed to explore how the gesture recognition is used for computerized eating habits (and diet monitoring) to perfectly distinguish eating periods from non-eating episodes[9]. Similarly, a new wearable computer called e Button is structured to control diet, regulate physical activity and avoid sedentary behavior of the aged and visually impaired people[10]. On similar lines, an Automatic Dietary Monitoring (ADM) is developed, based on ubiquitous sensors implanted in an acoustic ear wearable device to sense vibrations of chewing food[11]. Furthermore, an ear based wearable microphone is proposed to sense chewing sound of any eatable. The

framework of mobile "wearable in-ear microphone" is designed with the help of a common Bluetooth headset using two recognition stages which employs counting algorithm: ldquochew-likerdquo signal recognition with chewing affirmation phase[12]. Last but not the least, a dual-phase recognition process is suggested by the behavioral medicine psychologists to detect arm actions for intake of human meal. Here, the received arm gestures data can be used for monitoring human diet using inertial sensors[13]. In this way, we have seen the importance of wearable devices in diet regulation.

Although the multitude of wearable devices have been put in place to assess the orthopedic profile of the people in real time environment, there is a dearth of home based solution to the orthopedic problems experienced in daily life. Thus, this paper tries to complement the assessment potential of the wearable device by providing suitable recommendations in the form of specific exercises and nutritional diet to the users based on their recorded activity status. On the basis of extensive literature on wearable devices used in orthopedic problems and the identified research gaps, we frame two objectives for our study. Initially, we aim to provide orthopedic recommendations to the users based on their activity status recorded from wearable device and latter prescribe nutritional diet based on the symptoms observed in the people of different age groups. To fulfill these objectives, we follow the survey based data collection technique as discussed in the next sections.

2. Research Method

The data collection is done in two phases, viz. orthopedic and nutrition. In the initial phase of our study, the primary data collection is conducted through a well-designed questionnaire consisting of orthopedic profile. The respondent is a senior orthopedician. We try to collect even the basic questions related to bone/muscle health of an individual of different age.

2.1 Orthopedic Health Questionnaire

In this questionnaire, we have included the following variables that can link the collected information to the data recorded from the wearable device, such as:

Body Mass Index (BMI): It indicates the appropriate relationship between weight and height of an individual, which indicates overweight and underweight individuals.

If BMI value is more than 25, it indicates overweight. If BMI is less than 18, it states underweight. In both of these cases, the orthopedic problems arise. Particularly, if BMI is higher than the normal range (18-25), it puts stress on the legs of an individual, which ultimately leads to arthritis.

Recommendations for Healthy Bones: Healthy diet provides healthy bones. Certain diet prescriptions can be: High protein diet, calcium rich diet, Minerals and sun-exposure.

Test Recommendation: As our application provides some activity recommendations to each age group, so it becomes necessary for us to ask the orthopedic specialist to recommend that at what age should a person begin paying attention to orthopedic health and what tests do you recommend to be done regularly.

Factors behind Bone Deformities: There are various factors that can affect the bone health or can lead to bone deformities as follows:

- Eating habits: Lack of nutritional food affects bones strength.
- Hereditary factor: If a person suffers from orthopedic problems at an early age, there might be hereditary factors behind this.
- Diabetes: High blood glucose level decreases bone density and leads to thin legs.
- Overweight: If BMI is greater than 25, it indicates overweight, which can cause arthritis.
- Caffeine consumption: Increase in caffeine consumption leads to decrease in bone mass and makes the person prone to bone fractures.
- Steroids use: Increased steroid usage leads to fragile bones and makes the person prone to bone fractures.
- Stress: It reduces bone mass.
- Environment: Weather conditions can affect bone health.
- Smoking: It is a high risk factor of bone deformity as smoking leads to decrease in holding calcium and mineral capacity of bones which in turn makes bone weak.

Particular Food items to be avoided: Avoiding particular food items can help a person in maintaining bone health. Particular food items to be avoided are: steroids, alcohol and junk food.

Physical activities to be done to maintain healthy bones: walking, workout, yoga, running etc.

Acuteness of orthopedic problem upon gender: Both men and women are more prone to orthopedic problems.

Immediate home remedy if person suffers from extreme muscular pain: Analgesic and muscle relaxant and hot fomentation.

Ideal lifestyle for a person to avoid orthopedic problem: Moderate physical activities like walking, running etc.

After completing the orthopedic recommendation phase of our project, we approach the dietician.

2.2 Diet Questionnaire

The questionnaire consists of different questions regarding nutritional food to maintain good health. We have also included the following variables that help us to recommend nutritional diet to the users based on their physiological data recorded from wearable device.

Calories Intake: It is an important factor for maintaining healthy diet for an individual. Each and every individual should take calorie as per its requirement, according to its age, weight and blood profile.

Water Intake: Significant proportion of a human body consists of water. So intake of water is an important aspect for healthy life because water eliminates toxins from the body.

Diet makes a person healthier from birth so the individual should pay attention to body nutritional requirement early from childhood.

Diet Recommendation: The healthy and balanced diet should consist of the following elements: Calcium, derived basically from milk and milk products, Protein: from pulses and eggs, Fiber: from oats, whole wheat flour, Minerals and vitamins: from fruits and vegetables.

Symptoms Prominent in Nutritional deficiencies: There are various symptoms that are prominent in nutritional deficiencies which are as fatigue, hair loss, fainting etc.

Ideal lifestyle for a person to have healthy life: Moderate physical activities like walking, running, complete balanced diet which include cereal, pulses, fruits, vegetables, milk and milk products, avoid oily food.

3. Results and Discussion

Wearable device is used for measuring the physiological parameters. In this paper, it is intended to measure the activity status of the user. The recorded values are stored in our android application with the help of Application Programming Interface (API). Further, the primary collected orthopedic survey data is fed into our application,

which is divided into two fields, viz. activity and diet plan. Health recommendations are provided to the user under each head. The physical activity recommendations are given on the basis of age group, while healthy dietary measures are recommended based on the symptoms. In this way, this android healthcare application works, as shown in Figure 1.
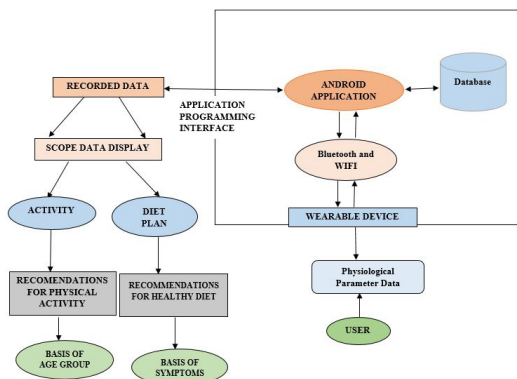

Figure 1. Architectural View of Application.

The above section presents an overview of the application. Now, we will see the data retrieval process in the wearable device application as shown in Figure 2. It takes place in a series of steps. The user's application is enrolled in the wearable device. After enrolment, the user needs to authorize and authenticate himself through his credentials. Further, permission is required from the user. Once user approves, the application gets redirected to the callback URL. In this callback URL, the access token for activity scope is generated in the form of URL fragment. Eventually, this access token is stored in his application through which he gets the access to all API.
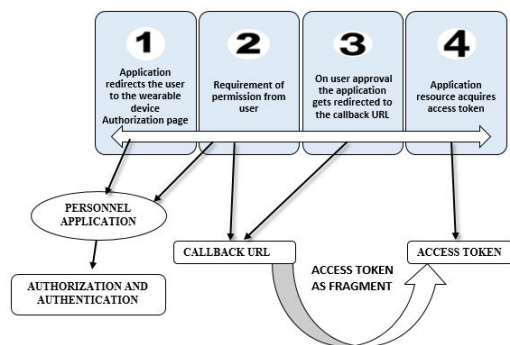

Figure 2. Data Retrieval.

Following are some of the snapshots of our application.

Figure 3 shows the different age groups in a drop-down menu for providing orthopedic recommendations. Figure 4 shows the recommendations provided to the selected age group in terms of diet prescription and physical exercises. Figure 5 shows the drop-down menu of symptoms observed in the users. Finally, Figure 6 shows the general diet recommendations for the chosen symptom.
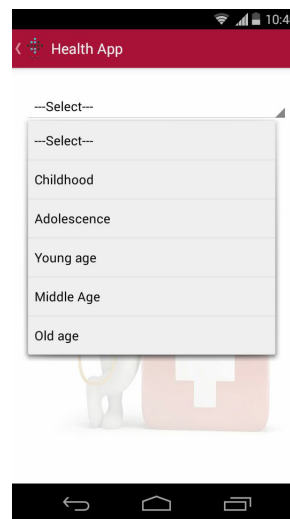

Figure 3. Drop-Down Menu-Age Groups.

Figure 3 shows various age groups to whom the recommendations are provided. Basically, human age is categorised into five cohorts, viz. childhood, adolescence, young age, middle age and old age.
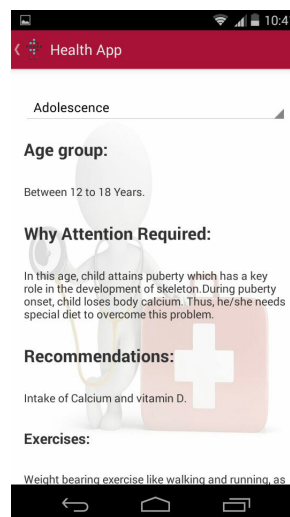

Figure 4. Recommendations Based On Age Group.

Figure 4 outlines the selected age cohort from the given drop-down menu of age groups stored in the application. Here it represents the recommendations provided to the
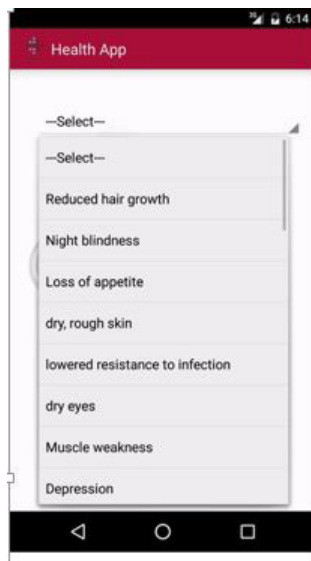
adolescent users.

Figure 5. Drop-Down Menu-Symptoms.

Figure 5 depicts the symptoms observed by the user for which the nutritional recommendations are needed. Though symptoms of any health problem differ from person to person, there are various prominent symptoms which are covered in our application, such as loss of appetite, dry skin, muscle weakness etc. as shown in Figure 5.
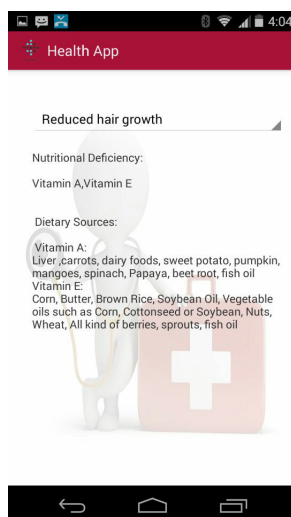

Figure 6. Nutritional Recommendations for Selected Symptom.

Figure 6 presents the nutritional deficiencies for observed symptoms. It also describes the dietary sources to meet out the particular nutritional deficiency.

4. Conclusion

This application presents a home based health care solution for the burgeoning population using wearable device. Wearable device helps to collect the activity status of the user in terms of number of steps covered and the amount of calories burned per day, which is further stored in our Android application. In second phase we conduct two surveys, viz. orthopedic and dietary health surveys and collect primary from orthopedican and nutritionist respectively. This medical experts' data consists of specific recommendations based on the stored physiological data in our android application. In this way, the application is used to provide dietary recommendations and suggest specific physical activities to the wearable device users.

The current application has limited scope in such a way that it provides only dietary and physical activity recommendations particularly for orthopedic problems. These recommendations, in general are precautionary measures. In future, the application should also cover endocrinal and respiratory disorders and must provide curative measures in the form of first-aid solution for all the covered health problems. Last but not the least, the application should be commercialized in order to provide its benefits to a lot more people, not restricting to a registered particular user.

5. Acknowledgement

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