M-health and Physiotherapy

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ABSTRACT
Rehabilitation exercises are those exercises that help in improving joint and muscle function, helping people stand, balance, walked. But these exercises work if done regularly and done as proposed by the therapist. Sometimes the patients has problems like scheduling their daily tasks, their commitment for doing those exercises, and some other difficultiessimilar to this. Thus failing to do the movementsand get benefit from the exercises. This paper proposes a system that provides an intuitive way for rehabilitation. This systemcontains use of pervasive health technologies for addressing theover difficulty. The system would provide a graphical interfacethat would help the physiotherapist to create exercises in 3Denvironment, wherein he would be animating a humanoid to showhow the exercise is to be done.This would show to be more intuitive to patients rather thanon paper. The system would also let therapist to monitor patient while he/she is exercising.

General Terms
Tele-rehabilitation, Pervasive computing.

Keywords
Mobile application, Rehabilitation exercises, Intuitive exercise program,Smart Health.

1. INTRODUCTION
Physical therapy cures injuries and promotes movements of injured body partsby examining the patient's body, diagnosing the patient and then treating the patient using mechanical force and movements which is carried out by physical therapists (also known as physiotherapist). Analysis aims to extend, and restore maximum functional ability throughout life action uses the patient history and the physical examination to find out what really the patient needs to do, to restore the mobility of the injured muscle. Physical therapy has many types of specialities:

- Cardiopulmonary
- Geriatrics
- Neurological
- Sports
- Orthopaedic and
- Paediatrics

With the developing technology worldwide, people have started using handheld devices to carry on their day-to-day activities.With this advancement, the demand for pervasive computing and 3D visualization of images and videos has been raised. The area this paper focuses on is a tele-medicine and tele-therapy system for helpingthe patient to get the help of the doctors at their home. When a patient undergoes a surgery, he may need a physiotherapy session to regain his/her muscle functionality. For this purpose the patient may need to take one-to-one session with the physiotherapist. The patient requires to do these sessions again and again till he/she regains the muscle functionality. Much man power, resources and time is need to do all this.

In today's life, it may be impossible for a patient to get sometime from the busy schedule and go for these one-to-one sessions.Also there are elderly people who get surgery but aren't able to goto the therapist for every day sessions, also there are people that live inremote location and due to this they are not able to get good healthcare services. To resolve such problems we will be developing a tele-physiotherapysystem, which would help to cater patients at theirdoorstep. The system would be developed in two stages. In the firststage the doctor will be provided with an interface where he/shecan animate a humanoid with the exercise the patient needs to do.

This would be done using the mobile device the therapist would behaving. After creating this animation, the therapist would be ableto record the animation and send the animation to the appropriatepatient. In the second stage we would be using sensors and otherdevices to monitor the patient exercises(If the first stage proves tobe successful).

As stated in the first stage, the therapist would be able to create3D animations, for which we can use the 3D computer graphicalrendering on mobile devices. This 3D visualization would be moreintuitive than the printed paper counterpart. Thus, it is hoped thatthis would help to improve the patient health in less costly way.

2. RELATED WORK
Previously, many systems were developed for telerehabilitation. [1] Shumei Zhang and et al from the Shijiazhuang University, China proposed a system for arm rehabilitation.

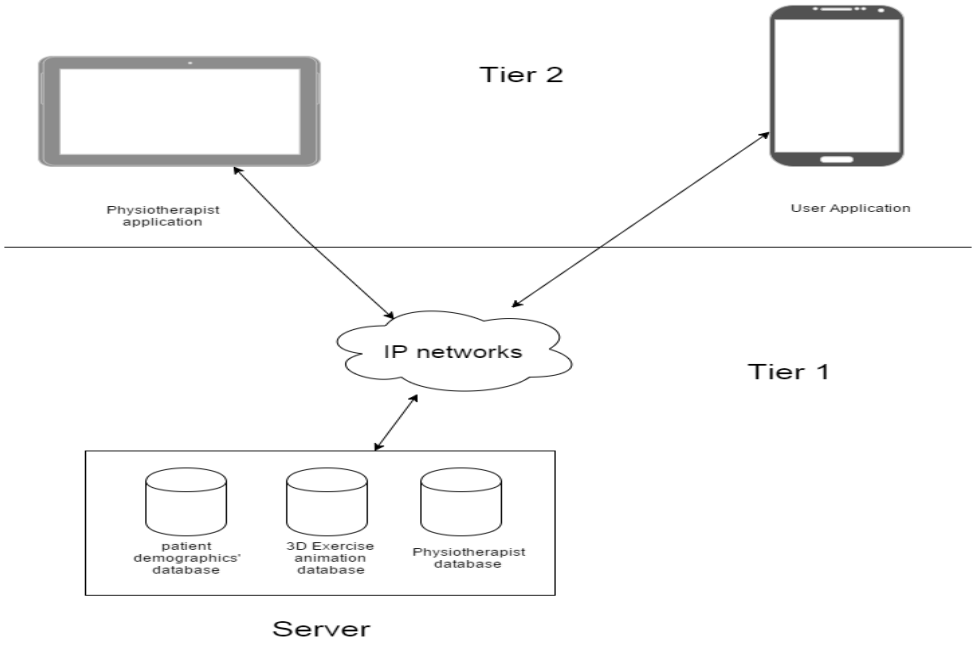

Figure 1: System Architecture

In this system they have used sensors to track the arm movement.They used to record data they get from the sensors and then using data analysis find out if the patient is doing the exercise appropriately or not. In [4], Maureen K. Holden and et al have used a virtual environment to treat patients with stroke. It was used to improve the upper extremity function in the patients. In it, they have used Polhemus sensors on the arm for finding the motion of the arm. The data obtained from these sensors was further scored by using an algorithm, which finds whether it closely matches with the way how the exercise is to be done. Thus increasing the efficiency of the exercise the patient done athis/her home. In the research conducted by Gabriela Postolache et al [2], they show how efficiently the ICT devices are being used for healthcare. Our work will be similar to the above stated work. However, our work differs in some aspects as stated above. Theproposed system would have a 3D environment on an ICT devicewhich is much viable to everyone. Also, there would be an onlinecollaboration system, which would help the therapist and the patients to collaborate synchronously or asynchronously.

3. SYSTEM ARCHITECTURE AND METHODOLOGIES

The main goal of this project is to provide a platform for physiotherapistsand patients. It allows physiotherapists to create physicalexercises using their mobile phones and distribute them to patientsbased on the patient'sdemographics. Physiotherapists have abilityto access and update the patient's medical record during the examinationof the patient. The proposed system architecture is shown infigure 1. As seen in the figure 1, there would be two different applicationsfor therapist and patient.

3.1 Interface for Physiotherapist

In the interface for therapist, there would have different things like creating a new exercise, assess patient demographics and option to have online chat with patients. For creating exercises, the therapist will be provided with a 3D environment which would have a humanoid. The therapist will be animating the 3D humanoid to show how the exercise is to be done. Thus, the therapist would be creating the exercise animation by just using his mobile device. After this, the therapist would share the animation with the patient. Thus, would be made a very simple task for the therapist. Before creating any animation, the doctor will assess the patient demographics, and then start creating animation for the respective patient.

3.2 Interface for patient

For a patient, it is necessary that he needs to be able to view the animation that was created by the therapist. For this purpose we would provide a player that would play the 3D animation. The patient would be able to cast it on a wider screen using devices like chrome cast. And there would be a window where the patient can chat with the therapist.

3.3 Collaboration of patient with doctor

As the patient and the therapist are separate from each other (as is the system's objective to be able to do therapy from a remote location), they need some system that will help the therapist to monitor the patient's exercises. In the proposed system, the patient and therapist will be able to collaborate with one anothersynchronously or asynchronously. As thissystem intends to use day-to-day ICT devices, an interface for the same needs to be provided. Further the communication needs to be secure as well as easy to use. For this, the system would use front camera of the mobile device for the therapist while, the patient would need to use a webcam or some other alternative device. For this purpose the open source Ring Buffered Network bus could be used.

3.4 Inverse Kinematics

The 3D humanoid body is represented as a hierarchy of body parts. Inverse Kinematics(IK) can be applied on 3D humanoid to control its joint movements. IK works on "bottom-up" system of rotation. Dealing with IK provides easy and controlled access to animate the body parts of the 3D humanoid that calculates the joint positions to achieve desired configuration.

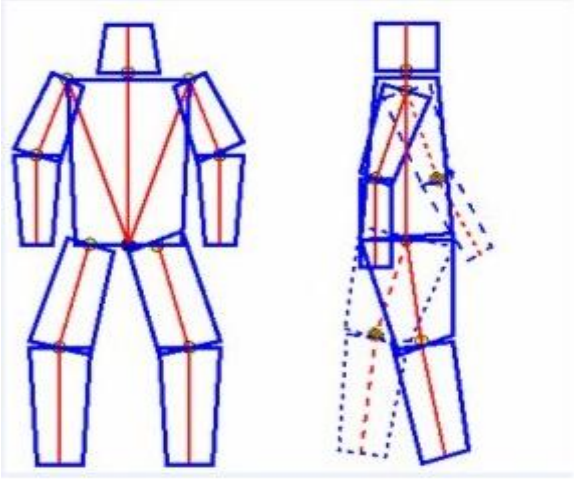

Figure 2: Inverse Kinematics

As shown in figure 2, IK helps us to connect body parts with one another. This provides much restrictions to bodily movements of the 3D humanoid. Due to this restrictions, the transitions look more natural.

4. CONCLUSION

This paper find the way to design and develop a platform for tele-physiotherapy. It would support synchronous as well as asynchronous collaborations and would provide a 3D animated video to the patient which would motivate them to do exercises. As in [5]-[9], we hope that this system would be successfully deployed in patients' homes for physiotherapy.

5. AKNOWLEDGEMENTS

Our thanks to Praxify Technologies, Inc., who have contributed towards the development of this project.

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