Wearable Optical Sensor For Low Back Pain Monitoring

Erna B. Tamizi
Faculty of Electrical & Electronics Engineering Technology
University Malaysia Pahang
Pekan, Malaysia
Email : ernatamizi@gmail.com

Mohd Anwar Zawawi
Faculty of Electrical & Electronics Technology
University Malaysia Pahang
Pekan, Malaysia
Email : mohdanwar@ump.edu.my

Roszitaida Adzemin
Faculty of Electrical & Electronics Technology
University Malaysia Pahang
Pekan, Malaysia
Email : rose8474@gmail.com

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***Abstract*—Low back pain (LBP) is one of the major issues related to health problems among adults especially people of working age range. Manual therapy is one of the approaches in treating LBP, aside from exercise, biofeedback, relaxation, massage, and rehabilitation. It is often conducted by physiotherapist or chiropractor to encourage joint mobilization of the spine under a controlled environment. To effectively monitor the progress of spine recovery in LBP treatment, certain device is required to assist the physiotherapist in collecting related static and dynamic spine data. Conventional ways to get the spine data are by using X-ray and MRI, but they are less preferable for repetitive use due to expensive and may cause skin irritation. Alternative devices for this application include goniometer, inclinometer, tape measure as well as spine mouse. Although these options are low cost, manual handling of the devices by inexperienced users will result in inaccurate spine data collection. The aim of this paper is to study and compare the performance of several spine monitoring devices that have been developed by past researchers and then to propose an alternative solution of spine monitoring sensor based on optical sensor that could provide continuous data of the spine kinematics. A sensor design using a microbending optical fibre technique could potentially give various advantages because of the small sensor size and low cost needed for sensor component assembly which will only use a visible wavelength LED and photodiode, and less affected to external signal interference.**

Keywords—wearable system, optical fibre sensor, plastic optical fibre, spine monitoring

I. INTRODUCTION

Lower back pain (LBP) is usually an excruciating condition that is experienced both in general and clinical treatment. According to Ministry of Health (MOH) Malaysia, the prevalence of LBP in most countries are between 10-63% while in Malaysia the rate is between 12-60%[1]. Low back pain is described as pain in the lumbosacral region, buttocks, and/or thighs. It is a painful condition where it can affect our quality of life and it can be harmful if left untreated. For some people, LBP will heal spontaneously without any treatment. This kind of LBP might be caused by a ligament or muscle sprain. On the other hand, one can suffer an acute or severe back pain which may lead to chronic back pain if no systematic intervention is carried out. If the pains go on for about less than 12 weeks before it heals, it is classified as an acute back pain. Meanwhile, if the pain continues after 12 weeks, it is then classified as a chronic back pain and it must be treated immediately[1].

The initial state of examining a LBP patients are by doing a history and physical examination towards the patients. As stated in The Malaysian Low Back Pain Guideline[2], both history and physical examinations are crucial in order to classify the problem background. During the physical examination, a physiotherapist will measure the range of motion (ROM) of the lumbar spine. There are three main points to measure the ROM and the normal range are shown in Fig. 1.

During the assessment, a physiotherapist will use a goniometer to measure the ROM of each lumbar in flexion (forward), extension (backward), and the lateral (side) bending. As shown in Fig. 2, goniometer is one of the conventional instruments that is typically used to measure the range of motion of human joints[3]. However, this tool has some limitations in measuring the ROM as the reading accuracy is highly depending on the examiner's prior experience and thus human error factor may occur[4]. Besides, the same goniometer should always be used for the same target applications in order to reduces chances of instrumental error[3].

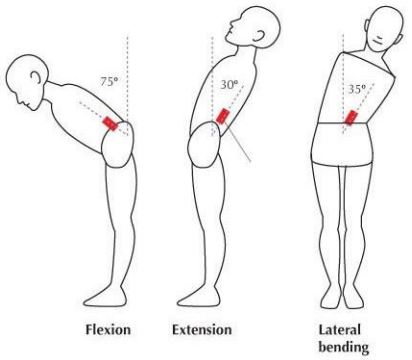

Fig.1. Physical assessment and the normal Range of Motion (ROM) for low back[5].

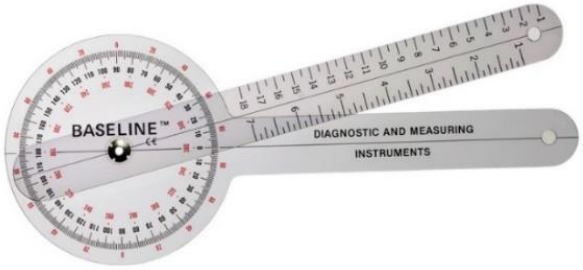

Fig.2. Goniometer