

Development of Portable Finger Clubbing Meter

S. M. W. Masra^{1, a *}, K. L. Goh^{2, b}, J. S. Henry^{3, c}, M. S. Muhammad^{4, d},
R. D. Djojodibroto^{5, e} and R. Sapawi^{6, f}

^{1,2,3,4,6}Department of Electrical and Electronic Engineering, Faculty of Engineering,

⁵Department of Medicine, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak (UNIMAS), 94300 Kota Samarahan, Sarawak, Malaysia

^awmmasnia@feng.unimas.my, ^bgohkl91@gmail.com, ^cjoys.sheena@gmail.com,
^dmсаufee@feng.unimas.my, ^eddrahardjo@fmhs.unimas.my, ^fsrohana@feng.unimas.my

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Abstract. Finger clubbing, also known as drumstick finger, is the medical symptom that is indicated by the development of the sponginess or swelling in the nail beds of nails and toes. The higher grade of clubbing on the patients can be easily identified with the presence of drumstick finger. The existing available measurement device to identify the early stage of clubbing required much time which is impractical for a busy clinic practice. This paper explains the determination of the finger clubbing by using the Digital Index (DI) measurement, which was deployed by implementing and developing the Portable Finger Clubbing Meter hardware and the Microsoft Visual Basic (VB) Graphical User Interface (GUI). Finger circumference values of nail-fold (NF) and distal interphalangeal joint (DIP) of twenty participants were measured using the developed hardware. Data analysis was then performed using the GUI for DI computation, and the presence of finger clubbing could be determined.

Introduction

Finger clubbing is a phenomenon where an individual experiences deformity in the fingers, in which the occurrence of focal and bulbous swelling of distal phalanges is accompanied by the alteration in nail bed's angle [1]. Finger clubbing causes the nail-fold angles, shape, depth, and width of the terminal phalanges of the fingers to grow in an abnormal manner [2]. Finger clubbing is frequently associated with hypertrophic osteoarthropathy (HOA), the generation of subperiosteal new bone, which is the formation of bone beneath the periosteum [3]. Periosteum is the dense fibrous membrane that covers the bones and it functions as an attachment for muscles and tendons. Hippocrates is the first person who described the possible clinical sign of chronic diseases in 400BC [3]. Nevertheless, the underlying pathophysiology and clinical significance of finger clubbing are still subjected too much arguments and debates.

One of the possible cases that are closely related to finger clubbing includes pulmonary tuberculosis [4]. Matsumura et al. had carried out a study on the relation between tuberculosis and finger clubbing in 1966. They had discovered that for clubbed finger, the end of phalange is swollen with respect to the middle or proximal phalange. Nevertheless, the most significant feature of clubbed finger observed is the profile angle with projection of more than 160° and the abnormally curve-shaped nails [4].

According to Goroll and Mulley, 'megakaryocyte hypothesis' states that the failure of fragmentation of megakaryocytes, which are the gigantic-sized bone marrow cells, into the platelets at the finger or toes blood vessel contributes to clubbing [3]. The disruption of normal pulmonary circulation would result in the inability of megakaryocytes to be fragmented into platelets. The megakaryocytes, which are of larger sizes than the platelets, lodge in the fingertip during the pulmonary circulation [3]. Then, megakaryocytes are fragmented into the platelets, and the platelet-derived growth factor released results in unusual growth and vascular permeability.