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Prior Detection of Sores in Diabetic People Using Piezo

Chetana Krishnan [1], Sneha Srikanth [1]
B.E Biomedical Engineering SSN College of Engineering
B.E Computer Science and EngineeringSri Sairam Engineering College

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ABSTRACT: The number of people affected by diabetes is increasing by 6.5 percent every six months. Hence they are either suggested to amputee any part of their body avoid the spread of infection. Once they get their parts amputated, then they are prone to deficiency in immunity levels which can lead to slow healing. This wound on exposure to continuous non-healing may slowly turn out as sore which causes permanent scars and inflammation. Hence it will be better if there is some solution that can detect the sore formation. We are achieving this using the principle of piezo materials. The piezo lining will be placed in the shoes of the patient and it can be detected from the force (output) produced by the linings. The process does not require any manufacturing of special shoes. These linings can be placed in any shoes that the patient wears. The linings are designed as per the center of gravity and default force measurement.

KEYWORDS: Piezo, Force, Load Cells, Lining, Flexion, Diabetes, Sores.

I. INTRODUCTION

Wound healing and sore formation are one of the major challenges faced by any diabetic patient in their life. The sore analysis is only subjective and currently, there are no effective solutions to solve the same. Due to this, they are forced to be bedridden. According to the data collected by the national health portal of India, 67 percentage of diabetic people are prone to sores and 89 percent of diabetic people are diagnosed with full-body sores. As of now, the proposed project will be able to detect the prior formation of a sore in the appendicular region of the human body. If the sores are left to dry out, then the patient's legs are to be amputated in order to prevent spread which will restrict the person's lifestyle and day to day activities. This can even lead to another type of sore called bedsore which is because of the bedridden nature of the patients.

The remaining part of the paper is divided into the following sections. Section 1 is dealt with the related works. Section 2 is dealt with the work plan. Section 3 is dealt with accuracy. Section 4 is dealt with the future work and enhancement followed by the conclusion.

II. RELATED WORKS

[1] Vohra RK, McCollom CN's review of pressure sores is a timely reminder of the continuing silent epidemic of pressure sores both in hospital and in the community. R K Vohra and C N McCollum postulate that the widespread introduction of these risk scales into clinical practice may lead to increased awareness of the problem and facilitate more effective preventive care.
Pressure sores. BMJ 1994.
[2] Waterlow J.Pressure Sore Prevention Manual.Taunton: Newtons, Curland, 1994. He worked on early detection of sores using insulin-dependant plots and insulin refill plots
[3] Gebhardt K's article aims to assist nurses in the selection and use of pressure-relieving equipment to prevent pressure sores in bed-bound elderly patients. Preventing pressure sores in orthopedics. Nursing Standard 1992.
[4] Hagisawa S, Barbanel J reported the prevalence and incidence of pressure sores in a particularly high-risk group of patients who were receiving what they believe to be the best preventive procedures. The risk of pressure sore development was assessed by means of the Braden scale. The limits of pressure sore prevention. J R Soc Med 1999.
[5] Carl had an idea to inculcate diabetes using the normal mattress which can heat and cool simultaneously. The heat of the mattress and the heat of the patient will neutralize and the final result will be taken as the heat. This heat can be traced back to its position and the sore developing region can be found.

III. WORK PLAN

A. Principle of working: A piezo material works on the principle of giving an output when the input is in the form of tension or stress. So, when a piezo lining is placed on the shoes, it will directly get the force applied by the person while standing

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as an input. Hence the piezo produces the required output from that. To increase the efficiency of the product, work done will be given as the input and the force will be extracted as the output. When there is a sign of sore development in the patient, the walking style (COG) will tend to differ, giving out slight variation in the default value of the force. This force will be converted to work done by a load cell and the piezo will produce the output for every change in the work done. The region of piezo which gives out the force will be taken as the sore developing region and additional treatment will be given on that.

B. Default force calculation: A wearable load cell will be exactly placed at 56 degrees from the flexion point of the knee. Since the knee is the major bone site, the force acting on the legs will not cross the joint. The person will be asked to stand and the force acting and reacting will be measured followed by work calculation. The load cell will be fixed with the display monitor.

Figure 1: A mannequin fixed with the load cell.

The structure of the load cell is shrugged in order to ensure a good grip around the knee region. A suitable PID machine learning model was constructed using MATLAB and regression techniques. The data set was collected from Kaggle 2020 and is listed below in encrypted form (machine learning form) in the form of text.

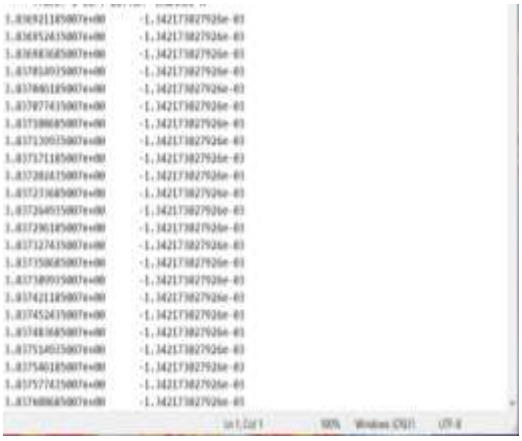

Figure 2: Data

Figure 3: CAD assumption of how the wearable load cell will look like.

C. Positioning the piezo: Once the default force is calculated, it will be categorized or tuned inside a tuner. The piezo will be placed in those areas of the shoes where the default force is acting the maximum. For example, if a person's default force is acting its maximum in the ankle region, the lining is placed there. The limit of the method is that it works only when the patient is wearing shoes with a higher stem. The following is the table that shows the various angles in which the piezo can be placed. The position of the piezo depends on the flexion rate or the extension rate exerted by different parts of the leg. This flexion rate will be responsible for the momentary force exerted by that region.

Part of leg	Flexion rate (degrees)
Knee joint	35
Cortical bones	21
Shinbone	12

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Stem of leg	8
Feet	2

Table 1: Angular data

D. Principle of working: Once the default force is determined, the lining is placed on suitable parts. Depending on the heat emitted by the sore developing region, the heat is given as work is done and the output is extracted as the force is done. The lining detecting this force will be the sore developing region. The amount of force tells the time period that the sore may take to develop. The force will be sent to the screen/ monitor using a bolt module which will be stored as the person's record. The principle of working is explained below in a precise manner. Different regions will have different threshold points and the force coming out will also follow that threshold point. If the force exceeds the threshold, it means that the sore has already developed and it may rage out at any time.

IV. ACCURACY

The accuracy was measured using a static strain gauge and the value from the strain gauge perfectly matched the value from the load cell.

V. FUTURE WORK

In the future, the lining position can, even more, be accurately measured using the rotating strain gauge. The output can be extracted as a graphical form rather than as a numerical form which is more efficient in determining the peak value of force which will determine the sore developing area very accurately.

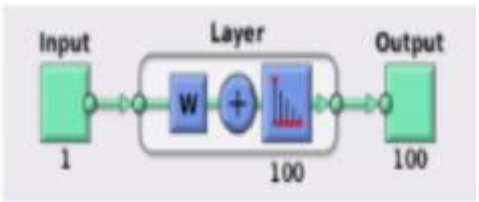

Figure 4: Model Simulink

The input fed is from the text file and the output will be processed from the layer block. The layering is automatically fixed by the interpolation algorithm. From this system, we can get the current required interpolation data of angular motions from different body arts where the piezo will be placed.

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[5]. Carl, Alumnus, Pubmed 4563, "Diabetes automatic detection using automation and machine learning