Mass conversion into force via robotic device

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ABSTRACT – The purpose of this research is to propose a conceptual design of a robotic device capable in using force to carry out weighing verification instead of using standard weight. This research is intended to reduce and minimize the usage of existing standard weight and offers safer and better working environment. This certainly contributes in a better weighing equipment verification process in fulfilling the legal metrology requirement in Malaysia.

1. INTRODUCTION

Malaysia government under The Ministry of Domestic Trade and Consumer Affairs (KPDNKHEP) has appointed and given responsibility to Metrology Corporation Malaysia Sdn. Bhd to conduct weighing verification under the weights and measures act 1972 (ACT 71), Regulations and Orders [1]. Every weights and measures for trade purpose in Malaysia has to follow this regulation under section 11 as follows *"For the purposes of this Act, the expression "use for trade" means, subject to subsection, use in Malaysia in connection with, or with a view to, a transaction for the transferring or rendering of money or money's worth in consideration of money or money's worth"* and in section 14 mentioned *"Stamping and verification of weights and measures, etc., and issue of certificates of verification. Subject to subsection, every weight and measure and instrument for weighing or measuring for use for trade shall be verified and stamped by an Inspector with a stamp of verification and a certificate of verification shall be issued by such Inspector at the time of stamping every such weight or measure or instrument for weighing or measuring"*

Verification or stamping is a standard procedure for all weighing instruments use for legal trade in Malaysia. The verification is carried out in order to ensure that the equipment meets the requirement and specification that complies with the standard regulations in Malaysia under the National Metrology Institute of Malaysia (NMIM-SIRIM). Currently, the weighing verification is performed by metrology officer.

The Newton's second law of motion states that the acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object [2] as in Equation (1). In physics, force is any interaction that will change the motion of a mass and could be either push or pull.

$$f = m.a \quad (1)$$

Where F is force in N, m is the mass in kg and a is the acceleration in ms^2

The objective of this project is to represent force, convert the force into existing standard weight and execute verification process.

Force sensor will be used for this research because it could be converted into mass via Equation (1). Force sensor will be set as a reference to determine the amount of mass to be applied on the weighing scale.

Linear electric robot or also known as gantry robot is selected for this purpose, this type of robot has two or three principal axis that could move in a straight line. The robot has sliding joint that could allow its robotic wrist to move up, down, backward, forward, in and out. The gantry robot has high positioning accuracy and cheaper compare to pneumatic and hydraulic robots. In addition, the user could set the coordinate in x, y and z axis.

2. METHODOLOGY

Force sensor that could convert into mass in the range of 1 to 20 kg will be used in this research. While electrical cylinder will be used to set the amount of force in the force sensor to be applied on the weighing scale.

3. DISCUSSION

This research focuses on designing a new concept to verify the weighing scale by using force sensor. The robot will perform the weighing verification by using force sensor. The test will include the center and corner weighing scale position. It will also measure the weighing scale sensitivity according to the program set by the user. The result will be displayed in Kilogram (Kg). Figure 1 shows the concept illustration of this research

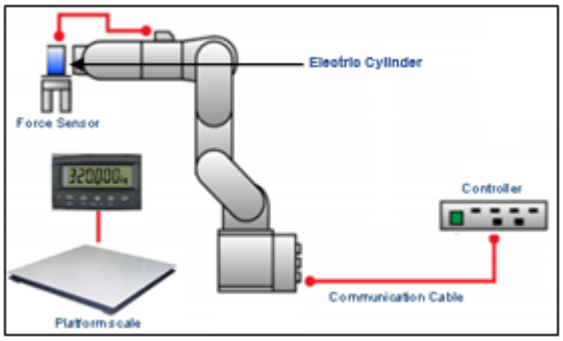

Figure 1 The ROC Curve for Back Pain Cut off Score of ≥ 1.5 Score

4. SUMMARY

This concept is an improvised version from typical weighing verification by using standard weight in Malaysia. This design shall contribute on the improvement of weighing verification process in Malaysia. By using robots, the outcome is expected to be more accurate and precise as compared to manual handling. Robots also could perform tasks faster than human, more consistent and efficient. I would like to acknowledge UTeM and Metrology Corporation Malaysia Sdn. Bhd. to allow me to proceed with this research and studies.

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[2] Lesson- 3/Newton-s-Second-Law, 2020 The Physics Classroom.