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An Improved Features of Health Screening Test System for Malaysian Social Security Organisation (SOCSO) Programme

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Abstract

The purpose of this paper is to improve the features of Health Screening Test System (HSTS) on Social Security Organization (SOCSO) program as physical evaluation for musculoskeletal disable workers (MSDs). SOCSO existing functional testing system are not suitable because of the evaluation was recorded manually peg board too high for Asian people. The occupational therapist whose involve in all the procedures is just doing the judgment in times to determine the capability of the patients. The functional capacity evaluation (FCE) technique is based on the functional range of motion evaluation that consist of positional tolerance respecting to time-motion testing on HSTS peg board and it is by referring to the original work movement. The main features of HSTS are able to measure speed, acceleration and evaluation of SOCSO's patients for returning to work based on SOCSO's requirement. In order to validate the accuracy of the proposed model, HSTS is used to evaluate the patient's positional tolerance and then the result would be compare over the time frame which is Method Time Measurement (MTM) standard. This method is able to provide information and feedback for therapies as a status of patients. It is found that the proposed model is superior in getting the accurate time test for patient's movements besides practicable and suitable for physical evaluation on MSD patients.

Keywords*: social security organisation (SOCSO), health screening test system (HSTS), musculoskeletal disorder (MSD)*

1. Introduction

The Social Security Organisation (SOCSO) Malaysia has organized the Health Screening Programme (HSP) with the purpose of promoting a healthy lifestyle. SOCSO existing functional testing system are not suitable because of the evaluation was recorded manually. In addition, it is not suitable for Malaysian people because the original peg board is too height and administered by an occupational therapist whose job requires them to use their subjective judgment at times to determine the capability of the patients. So, it will produce the human and instrumental error and can affect the result doing by the patients. This project is made to improving the efficiency of evaluation required by SOCSO Rehabilitation Center. The benefit of this program is to identify the non-communicable disease from high-risk groups of workers [1].

The objectives of HSP are to give awareness about a healthy lifestyle as most of the workers do not take seriously about the disease. With the HSP, the workers will be able to avoid sickness and complications. The benefit of this program is to obtain early detection for workers and prevents disability and death due to non-communicable disease. The examples for the non-communicable disease are hypertension, osteoporosis, tick paralysis and asthma. Moreover, the HSP is offered continuously for all active workers aged 40 years and above.

HSP also can prevent the loss of income due to non-communicable disease of workers. There are several screening tests that include the physical examination, consultation, interpretation of medical finding and clinical advice [1]. SOCSO Malaysia has reported that the incident of work related to musculoskeletal disorder (MSD) has been rising planetary from 15 to 268 cases from 2006 until 2011 and most of the cases occurred in the manufacturing industry [2]. Another study on the prevalence of MSD among private medical center in Kajang, Selangor,

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Malaysia show that most injuries are at lower back 21.4%, followed by neck 13.6% and shoulder 14.6% [3, 5].

This system is capable of stimulating the patients functionally capacity evaluation that performs by workers based on their daily routine jobs. This evaluation has to be monitored by using a computer for real-time monitoring, referred to MTM time frame, displayed in the Graphical Users Interface (GUI) and store for analyze for determining an MSD injured a worker. Evaluation on injury workers testing is to measure the ability and limitation of limb movement based on speed and acceleration. Thus, the test time measurement is very fast to measure and requires automatic time recorder for the testing. This project is made to improve the efficiency of the evaluation method required by SOCSO Rehabilitation Center.

The remainder of this paper is organized as follows. In Section II, the research methodology is discussed. The result and analysis are discussed in Section III. Finally, the paper is concluded with the summary of the work.

2. Research Method

Since the development of HSTS evaluation is measured in term of speed and acceleration the method of functional range of motion (FROM) has to be carried out. This method is highly recommended due to its ability and simplicity in determining the effectiveness of movement capacity for MSD. HSTS is constructed for planning evaluation, comparison with MTM standard and providing feedback.

Figure 1 shows a general diagram of this system. The patient will be doing the positional test on the HSTS peg board. A 5V DC supply is supplying through the digital sensor and digital signal PWM generated and send it through Arduino Mega. Arduino Mega will convert the digital signal into the binary number and transmit it to the serial port. Digital sensor is used to capture the movement of pins. The sensor's circuit is designed base on its capability to capture movement when the position test is taken.

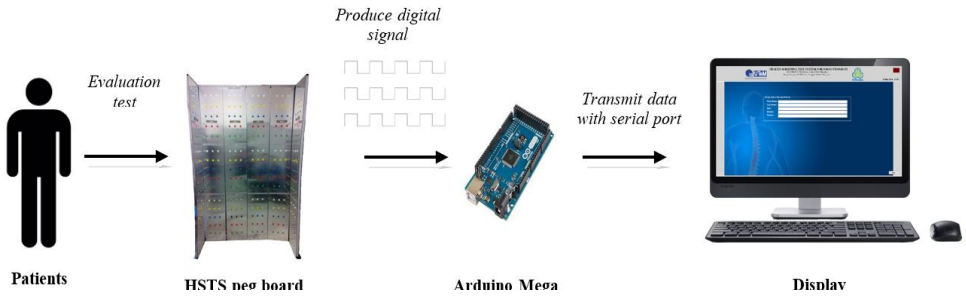


Figure 1. General Diagram of System

The project interface was designed by using VS2015 consist of time observed of the assessment, calculating the score and determine the performance rating of the evaluation. All the test time including set, repetition and time test will be shown on the computer display as a reference for the therapist guideline. The main purpose of hardware and software implementation is to ensure that all the sensors are chosen to satisfy the requirement condition for identifying the total score of evaluation.

2.1. Hardware Implementation

USB 2.0 cable is used for the communication and transferring data between Arduino Mega and personal computer (PC). The USB is used for transferring data through computer serial port through RS-232 standard. The standard defines the signal in data terminal equipment (DTE) and sends it to data communication equipment (DCE). The movement of positional test then analyzes by using VS2015 where all the score can be calculated and shown for the user interface.

The patient will move the digital sensors in the positional test taken for the evaluation. The signal of the movement is then captured by 8-bit parallel load shift register used in order to minimize the digital port used in Arduino Mega.

Based on SOCSO Rehabilitation Center, the requirement for this project must suitable for Malaysian's height. According to [8, 9], the average height of male and female in Malaysia are 164.7 cm and 153.3 cm. Thus, HSTS peg board build with heights of 210cm is suitable for "upper level reaching" test which is one of the positional test provided by HSTS. The design for the HSTS peg board is suitable for the mechanical and electrical part and the design consists of two separate plates for covering the wired RCA socket at the back of the peg board as shown Figure 2 (b).

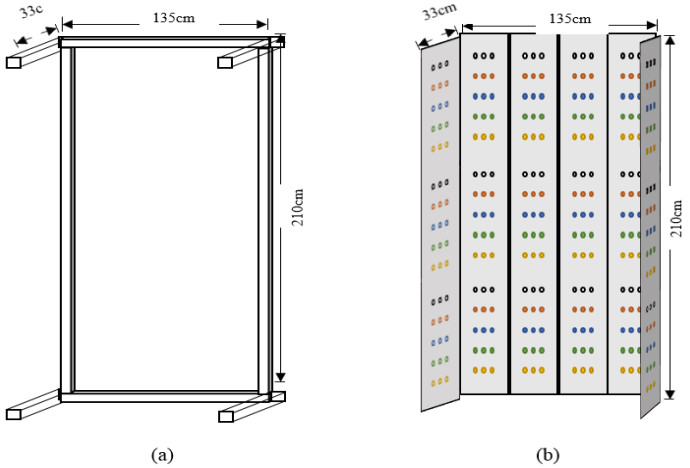


Figure 2. (a) Design Iron Frame (b) Design HSTS Peg Board

Since the HSTS peg board was designed such in big size (135cm x 210cm x 33cm) the structure must be stable and not interfere with the evaluation that is going to be carried out. The design of iron frame as shown in Figure 2 (a) is designed to support and make the HSTS peg board more stable.

2.2. Software Implementation

In the development of HSTS, software has been setup using VS2015. Figure 3 show the flowchart of HSTS construction. Port of sensors is initialized for digital signal acquiring based on Arduino Mega in VS2015. Initializing the sensors are for differentiating of the input signal and to ensure the system stability.

The signal received can be processed by using PC-based processing unit in term of digital data to obtain the desired performance score. VS2015 can do the calculation for the performance score and save it into a pdf file. This method is highly recommended due to simplicity for the functional evaluation on speed and acceleration. The formula of performance score equation (1) is used to determine the patient's score and its rating.

$$Performance\ score\ (\%) = \frac{output\ test\ in\ standard\ minutes}{rate\ time\ or\ machine\ time\ in\ minutes} \times 100\% \quad (1)$$

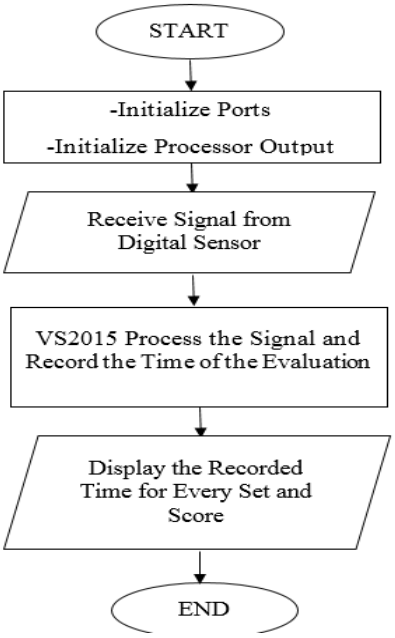


Figure 3. Flowchart of Health Screening Test System

The system is implemented by displaying the data contains graphic and text form. The monitoring display GUI design for HSTS software is shown in Figure 4. The overall system development consists of parameters such as the details of the patients, the positional test was taken, MTM standard, test time, evaluation date, time, performance score and rating.

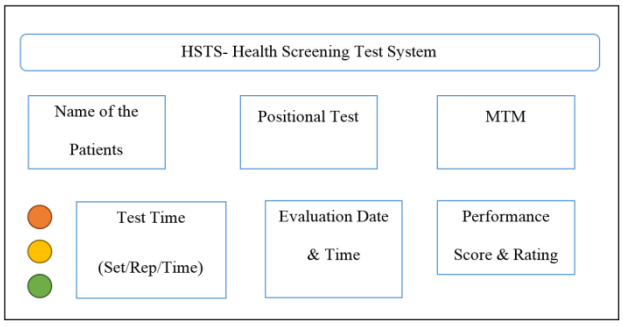


Figure 4. HSTS Software GUI Design

The project interface is designed by using VS2015. The result of the functional evaluating system are measured in term of speed and acceleration of SOCSO's patients and the calculating the score as shown in Figure 5.

All the test time including set, repetition and time test can automatically shown on the computer display. The main purpose of hardware and software implementation is to ensure that all the sensors are chosen to satisfy the requirement condition to identify total score of the evaluation. Troubleshooting has to be done by inspecting over the hardware and software implementation to ensure the value of score is satisfied.

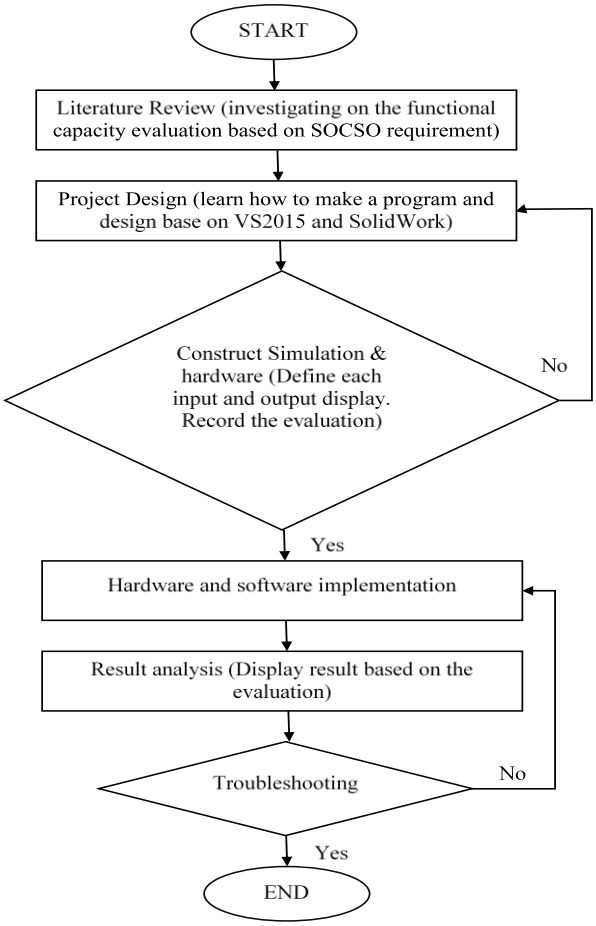


Figure 5. Project Workflow

HSTS software is user-friendly as it has several LEDs to indicate the status of the system. Different colors will light up to indicate the status of the system either the system is ready, pause or stop. The time required to complete the test is converted automatically into the equivalent MTM standard score. MTM percentage scores are ranked on the following basis shown in Table 1.

Table 1. Performance Rate and Percentage Scores

Performance Rate	Percentage Score (%)
Exceeding Above Competitive	141 and above
Above Competitive	101-140
Competitive	80-100
Entry Level	70-79
Below Competitive	0-69

The evaluation process maybe delayed for several reasons. The first factor is due to the condition of the patient itself. The patient may feel uncomfortable to continue the test. The second reason is due to the physical disability of the patient. The result then is recorded in real time monitoring and automatically saved in the destination folder chosen in pdf file.

The test details of HSTS evaluation system will be in one description form and can be saved at any location on the PC. This evaluation report containing the name of the patients, time and date of the evaluation, the positional test, the measured time, the scores and rating of evaluation.

3. Results and Analysis

The simulation and hardware designed are constructed based on the previous research. This project as a physical capacity evaluation based on the functional range of motion required an efficient controller such VS2015 to monitor and produce an accurate result. The development of HSTS software and hardware are aligned with the requirement of Social Security Organisation (SOCSO). Basically, this project includes of HSTS pegboard, HSTS circuit board and HSTS software as the equipment needed for conducting the evaluation. After the evaluation is completed the HSTS software will produce HSTS evaluation report automatically. The overall equipment of HSTS as shown in Figure 6 shows how this product is setup before the evaluation is taken. The HSTS peg board group box will illustrate how the evaluation is taken. The test will start when the patient start to move the pins from "Start" panel to "Finish" panel and the user need to click the "Start" button. The stopwatch will start to measure the pin movement and the test is finished when all the sets and repetition is completed. The software will automatically take time of lap for each set to monitor the competencies of the patient.

Figure 6. Overall HSTS Equipment

The LEDs act as an indicator to show the status of the evaluation. The green LED indicates the evaluation is still running, while the yellow LED indicates the evaluation is a temporary stop for rest time if the test provides rest time and red LED indicates the test is complete or stops reason of unable to finish the test.

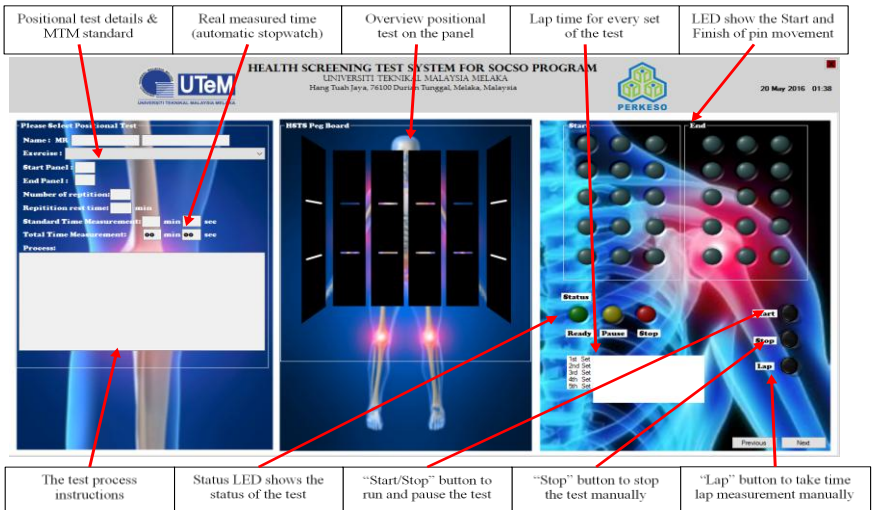


Figure 7. 2nd Page of HSTS Software

The score and rating of the performance together with the patient's detail will be recorded automatically in the report. The result is then saved into pdf file at any location of the PC. The saved pdf file can be safe for patient rehabilitation record or for future prediction of MSD. The report which contains the result of the evaluation is shown in Figure .

The HSTS circuit board as shown in Figure 9(a) is built with minimum input pin used in Arduino Mega for overall digital input. This circuit applies a 5V DC external power supply by supporting the current to all existing loads. The circuit is equipped with 18 D-Sub 37 male connecters attached with 18 panels of HSTS peg board.

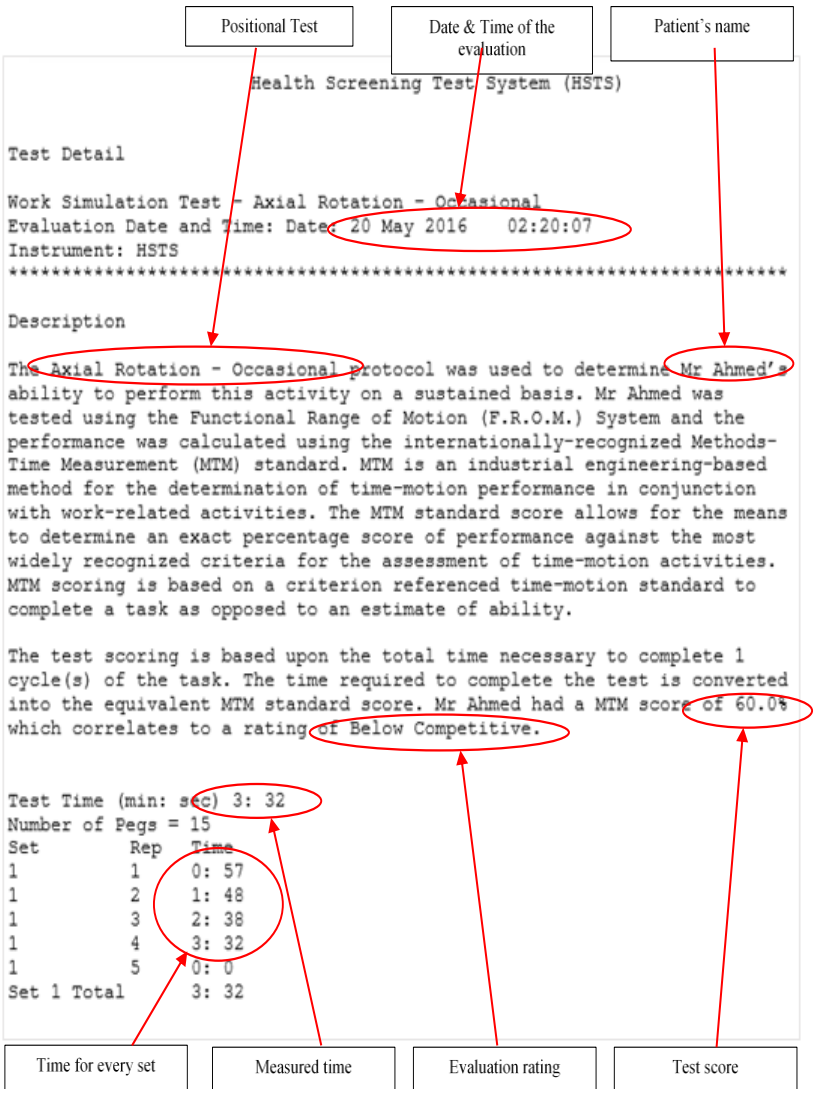
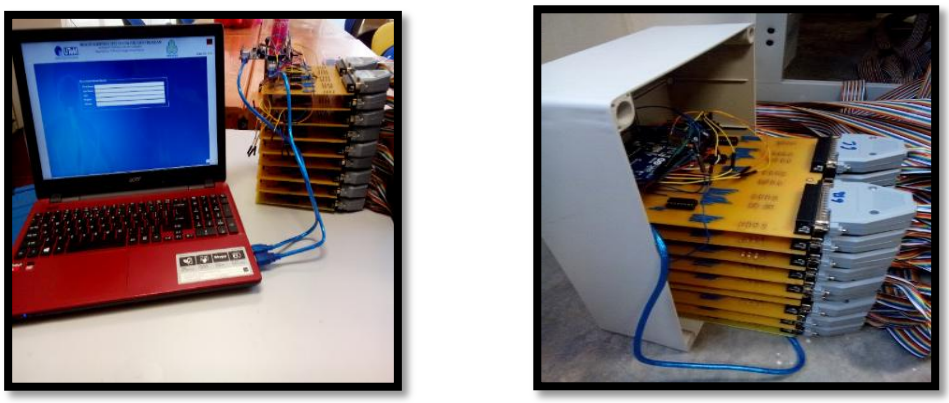


Figure 8. HSTS Evaluation Report

The signal that generates in HSTS peg board will be send through the 18 connectors as shown in Figure 9(a) for HSTS circuit board to analyze the signal and then send it to PC as shown in Figure 9(b). The circuit board can be used on any PC which has the HSTS software to run the functional capacity evaluation.

The patient needs to focus taking out the pins and place it on another panel during the evaluation thus, the HSTS peg board was labelled with colourful stickers with the purpose to stimulate the patient.



(a) (b)

Figure 9. (a) HSTS Circuit Board (b) Connection of HSTS Circuit Board

4. Conclusion

In the nutshell, the desired objectives have been achieved in term of design the functional testing system software and hardware based on the Social Security Organisation (SOCSO) health screening program requirement. The circuit is designed by using Proteus software and the GUI by VS2015. All the system equipment are chosen carefully to make the system stable and reliable. The objectives in term of developing an efficient and reliable Health Screening Test System have been achieved. The HSTS interface has made the evaluation more efficient by getting the accurate real-time test of every movement. The performance of the system has been tested and analysed with a few testing subject to ensure that the feasibility also has be achieved. The target of this project is to ensure that the MSD patients can be evaluated with automatic report preparation.

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