RECORDING WEIGHT TRAINING MOVEMENTS USING A WIFI ACCELEROMETER

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The purpose of this study was to use a wifi accelerometer to record training loads, and to provide trainers with real-time feedback with a view to increasing training efficiency. An accelerometer was attached to the wrist joint of an individual performing a bench press movement and raw accelerations collected. The MR3.3system was used to record data and to filter the signal using a smoothing algorithm. The number of repeated operations, the speed of movement and intensity, were parameters analyzed as important indexes for developing smart wearable devices for future use. The accelerometer developed in this study can establish a system of work-outs, using real-time training parameters as feedback to enable individual's to increase work-out efficiency.

KEYWORDS: work-out, accelerometer, training feedback

Introduction: The concept of 'Quantitative self' has witnessed a market explosion in wearable devices. With the advancement of technology, wearable devices can integrate an increasing number of functions. Wearable technology is existing technology that aims to develop a miniature lightweight devices that can be worn on a person`s body to retrieve subject specific information, and then transmit the data, via wired or wireless communication, to the cloud. Results can feed back to personal mobile devices where users can view their personal information. As wearable devices become more functional and integrated into everyday life, individuals are employing more convenient wearable devices to record their lives, such as; sleep time and daily walking time or number of steps. The current focus of wearable device development is to provide information on personal fitness activities and to help quantify self or self-tracking. Advances in wearable devices to track individual physiological information and living conditions, will continue to collect, monitor, and analyze data for self-adjustment, and facilitate the development of social and communication platforms that enable users to share information (Lupton, 2013).

METHODS: The development of a wearable "Weight Training Wisdom Aid System Re-training Parameter Setting and Detection" is outlined below. A schematic diagram of automated bench press action evaluation is presented in Figure 1. The expressions of the parameters are as follows:

(1) **extension speed** V1=($\int_{ti}^{ti+1} a\,dt$) (m/s) ………………………………………………..… Formula 1

(2) **extension force** F1=ma1(N)
(Load weight is m) (a1 is ti to ti+2 Maximum acceleration) …………………………………..… Formula 2

(3) **flexion force** F2=ma2(N)
(Load weight is m) (a2 is ti+2to ti+4 Maximum acceleration) ………………………………..… Formula 3

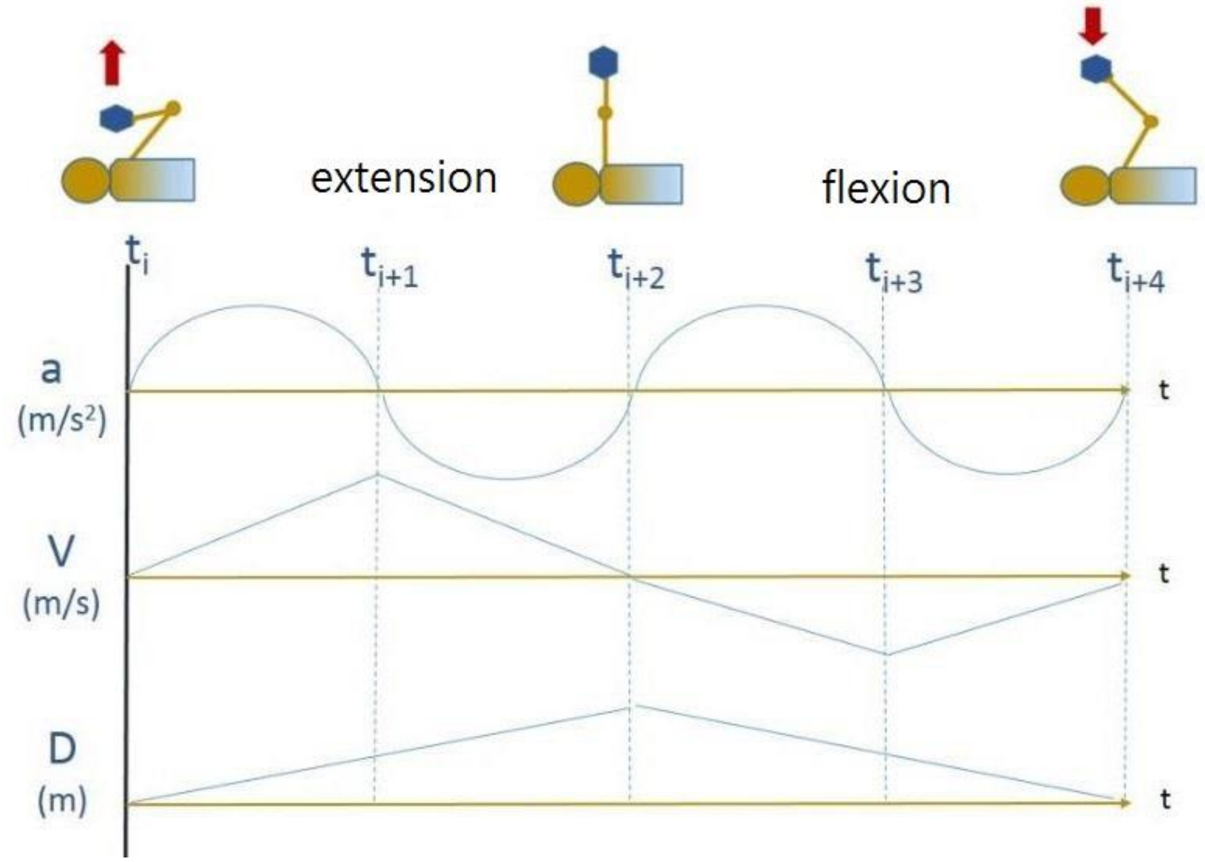

Figure 1. Kinematic parameter diagram for bench press motion.

A cc2650TI sensor is placed on the wrist. Signal collection for bench press action commences with implementation of the action control speed of 60 bpm. Descriptive statistics were used to observe the differences. *Collected signal display*: Grip: A-X minimum is greater than zero and A-Y minimum is less than zero. The current implementation plan is to use the axial g-values and the angle sensors (Gyroscope sensors) provided by TI Sensor Tag CC2650 platform, to compare the algorithms for the set re-training actions (Figure 1), and to seek out a valid and robust calculation method.

2. Bench press action testing
As shown in Figure 2, the self-developed wearable device was worn on the left wrist of the experimental participants. Signal extraction frequency was 36 Hz. Data were collected on three participants who held the preparatory posture for five seconds. The 6th second was followed by five5 consecutive bench presses. The actions of one bench press were: starting bar, putting down barbell, pushing, putting back the barbell.

Figure 2. Bench press action testing.

RESULTS:

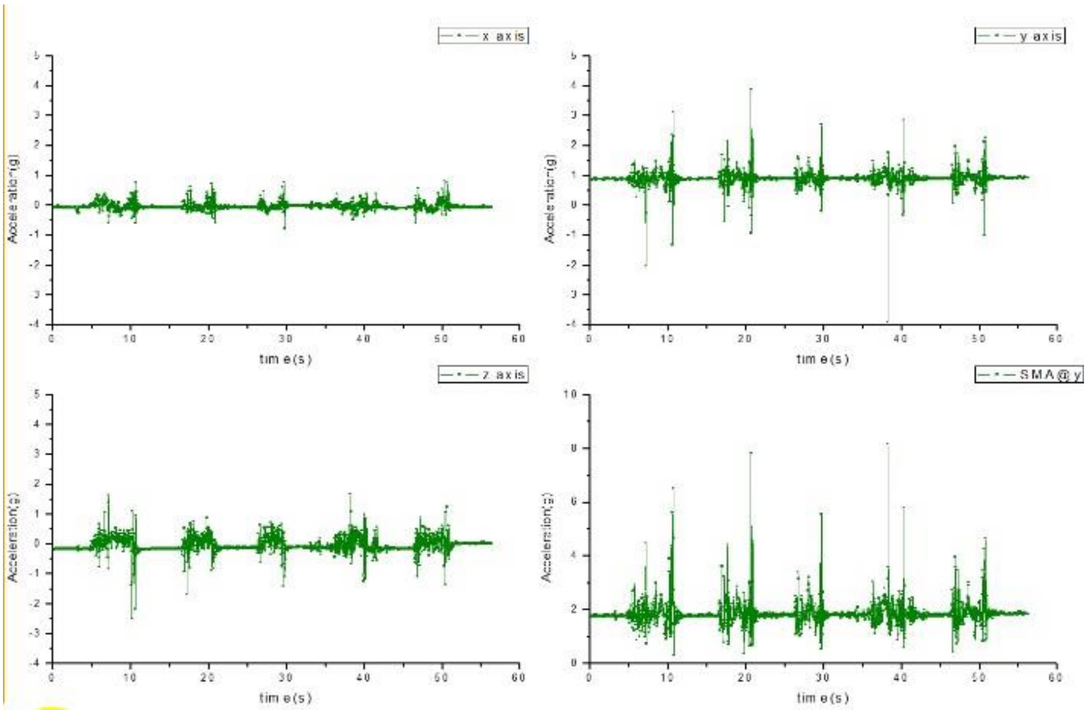

Figure 3. Bench press to detect the axial acceleration and resultant acceleration values.

The average velocity of each set of actions obtained by the experimental participants (extension/flexion /formula 1/formula 2) is shown in Figure 4.

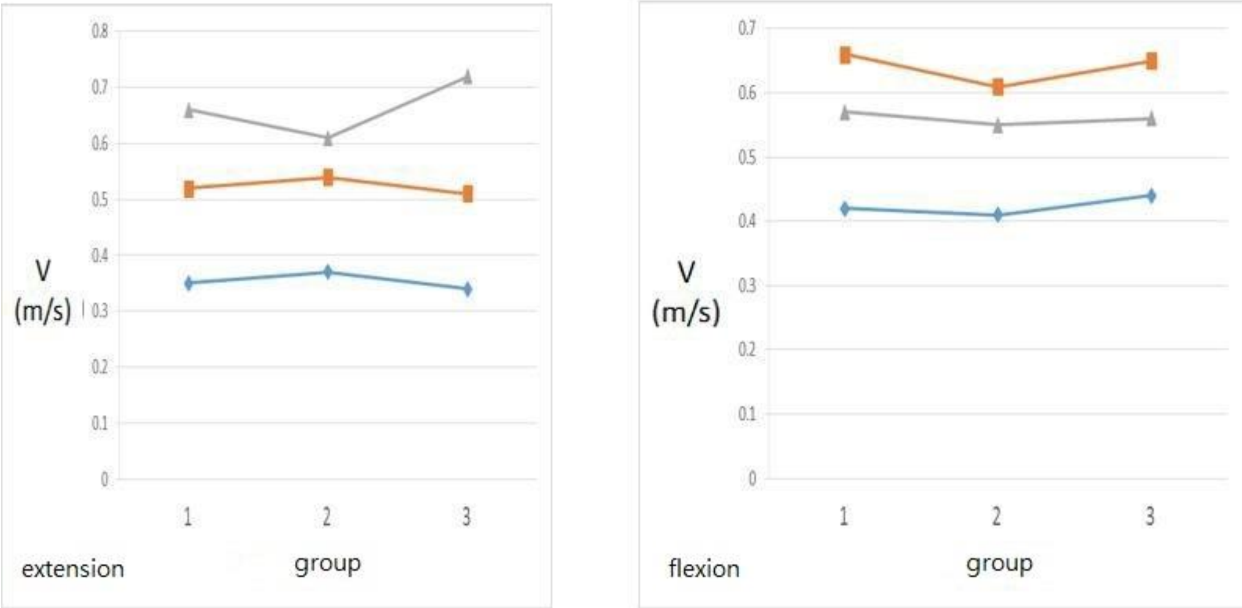

Figure4. Extension and flexion schematic diafram of average speed for each group in bench press training

Table1: Bench press elbow extension and flexion

extension	1.	2.	3.	M	SD
sub1	0.65	0.61	0.72	0.66	0.06
sub2	0.52	0.55	0.51	0.53	0.02
sub3	0.35	0.38	0.34	0.36	0.02
flexion	1.	2.	3.	M	SD
sub1	0.66	0.61	0.65	0.64	0.03
sub2	0.58	0.55	0.56	0.56	0.02
sub3	0.42	0.41	0.43	0.42	0.01

DISCUSSION & CONCLUSION: The purpose of this project was to construct a wearable weight training intelligence assistance system, which specifically outputs to a wearable weight training intelligence auxiliary device. Through this hardware device and the developed App interface and cloud database, the collected accelerometer data can be used for retraining (date/type/load/repeat/group number), and provide feedback (speed/strength/explosive/heart rate/intensity) through real-time feedback. Importantly, the device enables the collection and storage of the wearer's longitudinal data. Collected data and comparisons can be used to assess the effectiveness and efficiency of training.

References:

Lupton, D. (2013). Understanding the human machine [commentary]. *IEEE Technology & Society Magazine, 32*(4), 25-30.

Acknowledgements: The study's equipment, data analysis and found are supported by the project of Ministry of Science and Technology, Taiwan (MOST106-2410-H-153 -017).