Manufacture and Assessment of Photo Finish Devices in Comparison with Manual Measurements of Track and Field Tests

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ABSTRACT:
In the course of the amazing growth of science and technology over the last half-century, using technology in designing new methods of teaching movement skills has improved the performance of champions and led to setting new records. The present study aims to produce and assess the photo finish devices and compare the results to those of the manual measurements in the track and field tests. In order to do so, the photo finish device was designed and constructed as a portal. Afterward, the results of athletes' performances in a track and field test were recorded simultaneously by both a photo finish device and a handheld stopwatch. Dependent T-test was used so as to compare the results of both measurement methods. Results showed, that there is a statistically significant relationship between the average of obtained records from time measurement via photo finish devices and handheld stopwatch (t= -11/99, P= 0.0001).

KEYWORDS: Time Measurement, Photo Finish, Track and Field Tests.

1. INTRODUCTION

In the course of the amazing growth of science and technology over the last half-century, new scientific and innovative achievements are increasing the quality of human life every day. The advancement of technology in all the aspects of life has transformed the traditional ways of living and the advent of new methods has accelerated the pace of everyday tasks and also eliminated the manual methods of performing tasks.

Physical education is one of the fields which has had an increasing growth and development under the influence of the scientific achievements of recent decades. Applying various sciences such as physiology, anatomy, biochemistry and even applied sciences in the manufacture of sporting equipment as well as designing advanced exercise programs has increased the movement capability alongside with mental and physical capacities of athletes and has nurtured and developed their potentials.

Using technology in sports for designing innovative methods of teaching movement skills along with increasing improvement of champions' performances has led to the successive record-settings and breakings. On the other hand, the proximity of the physical and movement skills of champions to one another has made it necessary to manufacture the appropriate equipment for recording records and determining top athletes. Therefore, highly advanced devices are constructed owing to software and hardware sciences to record time and photograph sports contests. Using optical stopwatches as an inspiration, which are made for measuring time and setting records in hundredths of second in racing competitions, we designed and built an optical stopwatch to record time in agility tests.

One of the difficulties in evaluation in the field of physical education is an accurate and reliable assessment of final tests. To reach an accredited and reliable measurement, a suitable and accurate tool must be used to measure each test. Unreliability of measurement tools results in the decrease of accuracy and increase of error in the final evaluation.

One of the tests in physical education is the agility test or in other words, the speed of turning into different directions in a short distance. At university, this test is done in 4*15 meters and 4*9 meters and the test is measured and scored according to the distance passed over time unit. In fact, this test is a masculine capability in which an individual changes their position

and trajectory of the body deliberately in minimum time.

In this test, it's important to measure the speed and the reaction speed simultaneously. Thus, a stopwatch must be used which measures time from the start until crossing the finish line with the highest accuracy and sensitivity in hundredths of a second.

Measuring time in the agility test begins with the command of "ready, go" of the giver of the test and simultaneously pressing the start bottom and ends when test giver presses the stop bottom after several to-and-fros of the test taker and crossing the finish line.

The handheld stopwatch is often used for measuring time in the agility test in all educational levels. Despite its convenience, using handheld stopwatch has relative accuracy and reliability due to the human error and the decrease of sensitivity of handheld stopwatch after frequent utilization.

The first thing that reduces the reliability and creates error while measuring time using handheld stopwatch is the reaction speed and optical illusion of the test giver right at the moment of pressing the start and stop bottom of handheld stopwatch in the start and finish of the test. In addition, tiredness of the test giver and subsequently reduction of the accuracy of the measurement cannot be neglected.

Another thing that should be taken into consideration when using handheld stopwatch is the decrease of sensitivity of its bottoms after frequent utilizations which creates error recording the exact time of start and finish of the test.

After several years of teaching general units of physical education at university and facing the problem of using handheld stopwatch in the evaluation of students, we designed a stopwatch that not only has impressive sensitivity and accuracy in measuring time but also is not affected by the physical and mental conditions of the test giver. Therefore, the present optical stopwatch, inspired by photo finish devices used in the official track and field contests, was designed and built.

2. PERFORMANCE

The present device was produced for accurate time measurement of two-player or multiplayer track and field contests. Therefore, after the manufacture of the device, 50 students who were passing the unit of general physical education were selected and the duration of their 4*15 test was recorded by both handheld stopwatch and optical stopwatch simultaneously for each test taker. The device can use mains electricity or a 12-volt battery (automotive battery).

If a battery is used to turn on the device, the positive and negative terminals of the battery must be connected to the positive and negative pins on the main

terminal (X1) respectively. Otherwise, the fuzz and null of mains electricity must be attached to its adjacent pins. This device has four displays (7 SEG) which the first two displays show hundredth of second and the next two displays show seconds. Solid crystal was utilized for manufacture of the pulse of the stopwatch, therefore, the declared time is highly precise and accurate. The device uses the voltage of 12-volt DC and a 220/12 trans is used when the input is mains electricity so it is completely safe and there is no risk of electric shock. A picture of the built circuits is displayed below.
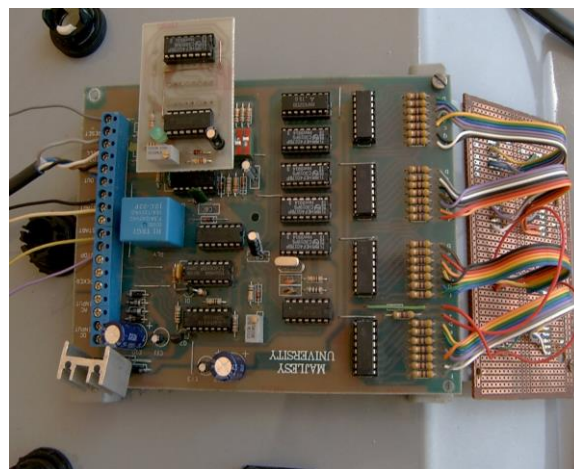

Fig. 1. A picture of the built circuits.

3. PESULT ANALYSIS

Since the errors of time measurement using handheld stopwatch decrease the reliability of the obtained scores, Optical stopwatch aims to decrease human involvement in the process of measuring time and record the real scores of test takers in agility tests in general physical education.

After building optical stopwatch, we started an experiment in order to compare the results obtained from the optical stopwatch and handheld stopwatch in measuring the accurate duration of 4*15 test.

The results obtained from this experiment shows that the time recorded by optical stopwatch is remarkably lower than that of recorded by manual handheld stopwatch.

Based on the time measured by both devices, the maximum time difference in the experiment was 1.29 seconds and the minimum time difference was 0.10 seconds. Regarding the fact that this test was scored on hundredth of a second, this difference is significant and affects the reliability of the final scores of students. In addition, the findings of this experiment confirmed the validity of the researchers' hypothesis regarding the influence of mechanical factors such as the decrease of sensitivity of handheld stopwatch bottoms as well as human factors like tiredness, optical illusion, and

decrease of reaction speed of test taker when using handheld stopwatch on decreasing the accuracy and reliability of time measurement of agility test (4*15).

Table 1. Descriptive statistics of obtained results.

statistic / Measurement methods	Handheld stopwatch	Optical stopwatch
Count	50	50
Mean	13.85	13.49
Median	13,80	13,41
Mode	15	13,32
Standard deviation	0.62	0.51
Variance	0.39	0.26
Minimum	12.92	12.7
Maximum	15.1	14.7
First quarter	13.3	13.02
Second quarter	13.8	13.4
Third quarter	14.2	13.8

In the following, the table of statistics obtained from the measurements is displayed. Based on the data recorded in the above description table, the differences obtained by the two of devices of handheld stopwatch and optical stopwatch are compared. The difference is statistically significant.

Table 2. Comparison of the results of measurement methods.

Statistic / Measurement methods	p	df	t	Standard deviation	mean	count
Optical stopwatch	0.001	49	-11.99	0.51	13.49	50
Handheld stopwatch				0.62	13.85	50

According to the results in the above table, the t - value obtained is -11,99. The mean difference of results obtained from the optical stopwatch method (mean 13.49, standard deviation of 0.51) with the results obtained from handheld stopwatch method (mean 13.85, standard deviation of 0.62) with the degree of freedom of 49, is statistically significant at the level of P =0.0001.

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