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Analysis And Evaluation of Momentary Forces and Reaction Time on The Starting Cushions with Sensors - Dynamic for Runners

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ABSTRACT

Starting cubes are a device used in the sport of arena and field races by speed-racing athletes to strengthen and stabilize their feet at the beginning of the race so as not to slip forward when hearing the starting gun. How can they improve the payment on these cubes? Why is starting important in fast running? When it comes to starting the race, athletes with the best reaction time, greatest strength, and the ability to accelerate as fast as possible can outperform their peers. It is important to remember one essential thing: when cubes are used, they should be intended to be able to help and allow the runner to accelerate, not to get him to full speed in the first few steps. Young athletes, therefore, tend to try to reach as quickly as possible once they start from the starting blocks .So, the starting cubes are designed to give runners great horizontal momentary strength, the most important indicator in the starting cubes is to get the right body angles .This research provides further developments and takes advantage of the start of the run to evaluate and analyze the forces and reaction time obtained by the movements of the two men on the cubes of starting the various fast running races (100m, 100m women's barriers), Men's 110mHurdles, 200m, 400m,400m Hurdles, 4×100m Relay, 4×400m Relay, 4x100m Mixed) For different categories. The idea of designing sensors - dynamic on the starting cubes came to the necessary need for such sensors that measure the amounts of power propulsion and reaction time of runners in these events taking advantage of the technology and scientific development in this field, if the start-up cushions are designed with sensors - dynamic and calibrated mechanically standard to provide the required measurement accuracy It was used to measure and analyze the strength and reaction time of the enemies of these elite Iraqi competitions by basing lab view workers, and the measured results obtained showed reasonable sensitivity and accuracy with a slight variation in their values, as well as measuring the change in strength over time for Runners perform this launch and acceleration based on the computer's vision tracking system. The proposed start-up cushions are promising to be used in a wide range of applications, including in-house and field laboratories for teaching, training, and monitoring the progress of runners during training and scientific research.

Keywords*: The cubes of the beginning of running. power analysis. reaction time. sense- movement*

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مجلة التربية الرياضية – المجلد (35) – العدد (1) – 2023. مجلة ذات وصول حر
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المستخلص باللغة العربية

تحليل وتقييم القوى اللحظية وزمن رد الفعل على مساند البداية بمستشعرات حس – حركية للعدائين

مكعبات الانطلاق هي جهاز يستخدم في رياضة سباقات الساحة والميدان من قبل رياضي سباقات السرعة لتدعيم وتثبيت أقدامهم في بداية السباق حتى لا ينزلقوا وهم يتقدمون للأمام عند سماع صوت مسدس البدء. كيف يمكننا من تحسين الدفع على هذه المكعبات؟ لماذا البداية مهمة في الركض السريع؟ عندما يتعلق الأمر ببدء السباق، فإن الرياضيين الذين يتمتعون بأفضل وقت رد فعل، وأعظم قوة، وقدرة على التعجيل بأسرع ما يمكن، يمكن ان يتفوقوا عن اقرانهم. لذلك، فان مكعبات البداية توفر دعمًا للقدم وتسمح للعدائين بالانطلاق للحصول على بداية أفضل وقت أسرع (جوتمان). من المهم أن تتذكر شيئًا أساسيًا واحدًا وهو عندما يتم استخدام المكعبات يجب ان يكون الهدف منها ان تكون في موضع يساعد ويسمح للعداء بالتسريع، وليس للوصول به إلى السرعة الكاملة في الخطوات القليلة الأولى. ولذلك فان الرياضيون الشباب يميلون إلى محاولة الوصول بأقصى سرعة ممكنة بمجرد انطلاقه من مكعبات البداية. لذلك يتم تصميم مكعبات البداية لمنح العدائين قوة لحظية أفقية كبيره، أهم مؤشر في مكعبات البداية هو الحصول على زوايا الجسم المناسبة. تأتي هذه الزوايا من وضعية الجلوس على مساند البداية. يقدم هذا البحث مزيدًا من التطورات والاستفادة من مساند بداية الركض لتقييم وتحليل القوى وزمن رد الفعل التي تم الحصول عليها بحركات الدفع بالرجلين على مكعبات البدء في سباقات الركض السريع المختلفة (100م , 100م حواجز نساء, 110م حواجز رجال, 200م, 400 م , 400 م حواجز, 4×100م تتابع , 4×400 م تتابع, 4*100م مختلط) ولمختلف الفئات. جاءت فكرة تصميم مستشعرات حس – حركية على مكعبات البدء للحاجة الضرورية لمثل هكذا مستشعرات تعمل على قياس مقادير دفع القوة وزمن رد الفعل للعدائين في تلك الفعاليات مستفيدين من التكنولوجيا ومن التطور العلمي في هذا المجال, أذ تم تصميم مساند بداية الركض بمستشعرات حس – حركية ومعايرتها ميكانيكيًا قياسيا لتوفير دقة القياس المطلوبة ،وتم استعمالها لقياس وتحليل القوة وزمن رد الفعل لعدائي هذه المسابقات العراقيين النخبة باستعمال برنامج Lab view ، وأظهرت النتائج المقاسة التي تم الحصول عليها حساسية ودقة معقولة مع وجود تباين بسيط في قيمها ، فضلا عن قياس التغير الحاصل للقوة مع الزمن للعدائين أثناء أداء هذه الانطلاق والتعجيل بناءً على نظام تتبع رؤية الكمبيوتر. وتعد مساند بداية الركض المقترحة واعدة لاستخدامها في مجموعة واسعة من التطبيقات بما في ذلك المختبرات الداخلية والميدانية للتدريس والتدريب ومراقبة تقدم أداء العدائين أثناء التدريبات وفي الأبحاث العلمية.

الكلمات المفتاحية: مكعبات بداية الركض. تحليل القوى. زمن رد الفعل. حس – حركي.

مجلة التربية الرياضية – المجلد (35) – العدد (1) – 2023. مجلة ذات وصول حر
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Introduction

All movements of biomechanics activities depend on the forces causing them to better understand the mechanism of these activities, for example, measuring the forces applied by the runner significantly and monitoring them by interested and trained people helps them to meet the amounts of those forces causing movements.

Various techniques have been developed to measure reactions and momentary forces made both at the start and during the jogging steps of the speed events in athletics, as the runners begin to exert great momentary force on the starting cubes at the moment of launch and continue to shed it after starting to achieve their highest acceleration, and the world runners can race 100 meters achieve about a third of their top speed at only about 5% of the total race time by the moment they leave the cubes (Setrakian, 1988, p. 67). The performance of the start of the fast run is associated with momentary momentum and time (Bowman, 1976, p. 84). The start cubes are designed with sensors of sense-mobility (Bezodis, Salo, & Grant, 2015, p. 120), to measure muscle forces against external forces simultaneously (Perry, 1992, p. 23).

In 2004, a miniature version of the space was created in geometric form, a square-shaped and rectangular jumping platform to measure the power exerted in physics and sports (Loturco, Pereira, & Kobal, 2004, p. 63). Also, strength measurement is usually used to be created from large commercial sky dies (about 40 × 60 cm) to (120 × 120 cm) and similar applications.

The start-up cubes equipped with engineering technology and their design are suggested to measure the forces resulting from push movements, measure the reaction time of runners and learn how to develop the momentary strength needed to get the body out of the starting cubes and an especially useful skill to master for any athlete. The design and simulation of the fast-running cushions began using the D-CAD3 program to determine the geometry of the prototype, and the manufacturer's support was directly calibrated, and these supporters were calibrated and subjected to various tests to assess their sensitivity and measurement accuracy, and The size parameters were analyzed using Lab VIEW as a virtual tool, identified the image that presented its era, which was of high speed in the following sections, and in fact, the researchers built the following questions

How do starting cubes help runners? How can I improve the post-launch phase/it will be discussed later.

The aim of this study is.

- The biomechanics of human locomotion can be explained by the physics of pendulums and springs. Humans have four locomotive strategies available: walking, jogging, running, and sprinting.
- These locomotive strategies become progressively less pendulum-like and more spring-like as speed and gravitational loading increase and contact time decrease.
- Each locomotive strategy has energetic and biomechanical consequences i.e., metabolic cost and risk of injury.
- Skilful human movement is characterized by adopting the locomotive strategy for a given speed and terrain that maximizes economy while minimizing injury risk.
- Movement strategy selection is influenced by several factors including habit, conditioning, and accurate sensory feedback about the external environment.

مجلة التربية الرياضية – المجلد (35) – العدد (1) – 2023. مجلة ذات وصول حر
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Technology: The start cubes of two types are designed according to the requirements of the fast running activities to measure the amounts of strength and reaction time and contributed to the achievement of the final achievement, and to clarify the mechanism of the two new devices must make an important comparison with other devices used for the same purpose in terms of recognizing the amounts of power and its time, appears in the form (1-a) A commercial power measurement platform commonly used to measure strength in internal laboratories and conduct some scientific research for an event often dedicated to measuring momentary strength when jumping, this platform is a "sensitive electronic electric balance with the ability to measure vertical, horizontal or both strengths as well as their outcomes and response to the magnitude of the change in accelerating the movement of body weight based on its work. Newton II's "F=ma" law, as shown in Figure 1-B, a platform created by (Ameen, Hassan, Al-Salakh, Saadie, & Alnajem, 2020, p. 2), and published in the Proceedings of the IEEE Conference in September 2020 at the Vancouver Canada Conference, consisted of its general infrastructure. From the main body of the panel, which was made of iron with the upper surface made of aluminium and a diagram of the strong platform and its sensor sites and conducted commercial transactions in a commercial style, and was provided with Korean-made sensors by SEWHACNM, with a total measurement force of 5000 Newton has a 2 mm volt sensitivity to measure the strength and other parameters. References to the specifications of trading cells were based on the application of vertical forces to the loading point. Digital recordings obtained from the recordings were collected via the data recorder on the laptop. Power measurement algorithms and other parameters have been implemented, and figure (1-c) which shows the mechanism of action of the two current devices consists of four starting cubes per cubic device and each cube with a sensor (CAL Sensor) with a capacity of up to 1000 kg and works A load cell is an energy converter that converts power such as tension, compression, pressure or torque into an electrical signal that can be measured and standardized. With the increased strength applied to the load cell, the electrical signal changes proportionately. It is one of the most common types of load cell used in stress, aerobic and hydraulic measures and is installed below the base of the starting cubes (assigned) by a 45-degree screw with the assigned to read the force of hostility accurately.

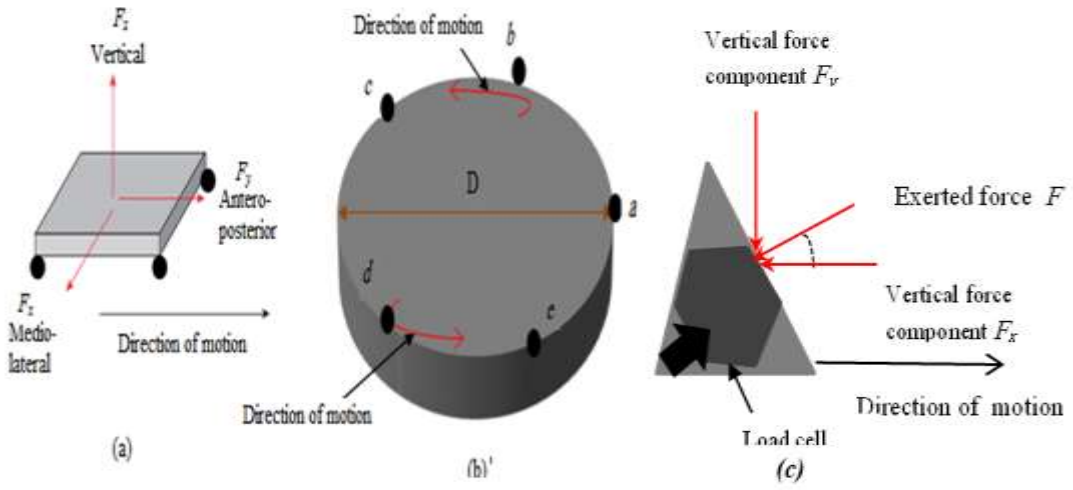

Figure 1 (1, B, C) Multiple Power Platforms

مجلة التربية الرياضية – المجلد (35) – العدد (1) – 2023. مجلة ذات وصول حر
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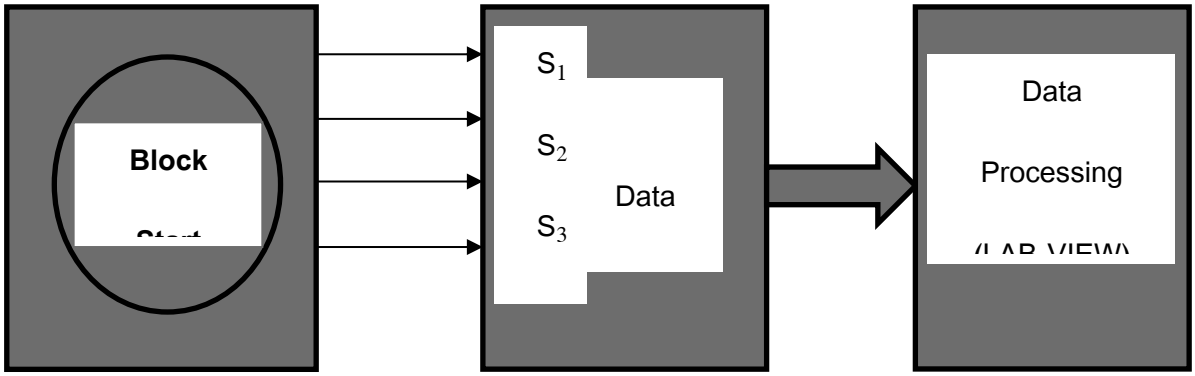

Figure 2 shows how data flows from cubes by sensors as an initial representative signal and obtains from download cells, and watching it collected by a data reader to collect digital data collected through Lab View.

Figure 3, shows the experience of sensors on both devices in the field.

Methods

Design procedures: Block START is designed with loading cells as cube-mounted sensors for each support and different steps have been made as shown in the following section:

Mechanical design: The two devices are designed to meet the requirements of the competition by selecting block **Start cubes**: HJ-2011 number two, which is the starting cube base for the fast running efficiency competition made of aluminum and connected to a plastic floor through the alignment nail to prevent displacement and foot anchor for the base of the starting cubes divided into a fixed pillar and a moving pillar, painted with chrome and the moving pillar panel made of rubber, which provides the performance of the prevention of slippage and the inclination of the pillar Moving and can be adjusted and all the steel parts are painted with electrostatic technology by automatic paint line after processing the surface to remove oils and phosphate, the starting cubes are a device used in the sport of track

and field by athletes in speed races; Examination of the two devices in the laboratories of the Department of Mechanical Engineering at Kofa University.

Electric Design

Load cell S has a number of these sensors (4) this sensor works with the principle of pressure and senses the mass up to the value (1000) kg and these sensors were distributed to four cubes i.e. each cube device starts front and back (**BLOCK START**) with two sensors (per sensor cube), these sensors read the amounts of force exerted by the athlete and its time above the surface of the cube Continuously, it senses the change over the cube's surface constantly and shapes 4 shows the load cell S shape.

Figure 4 Sensor

Data Logger (data reader) used to read the data from sensors and has been connected to it respectively, if this system provides the calculator with information from sensors, accurately records the data and at a reading rate of up to (100) readings per second, and as much as 5v and electronic circuits with six data reading channels, two for device 1, 1, 2 for device 2, 3 and 4, and the last two for device 3, 4 and the last two for Total strengths in the first device for sensors and total strength amounts for the second device and also for the senses with all noise mitigation data and electronic sensors set, and figure 5 shows the data logger data reader

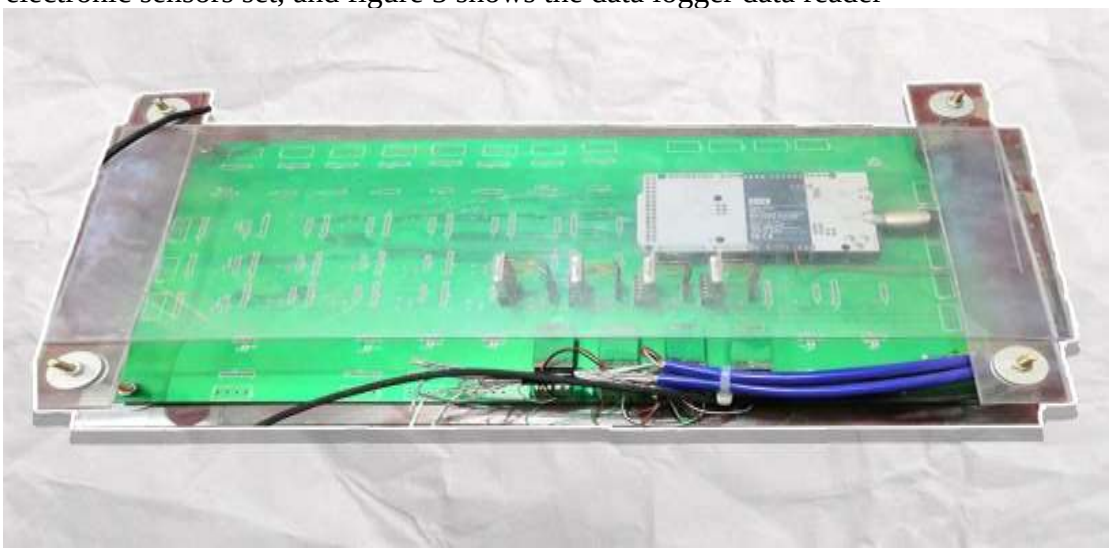

Figure 5 Data Reader

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Labview2019: Is the language of the program and uses the programming method for images and form (6) represents the interface of the program which contains six windows as mentioned in the bay at the reader

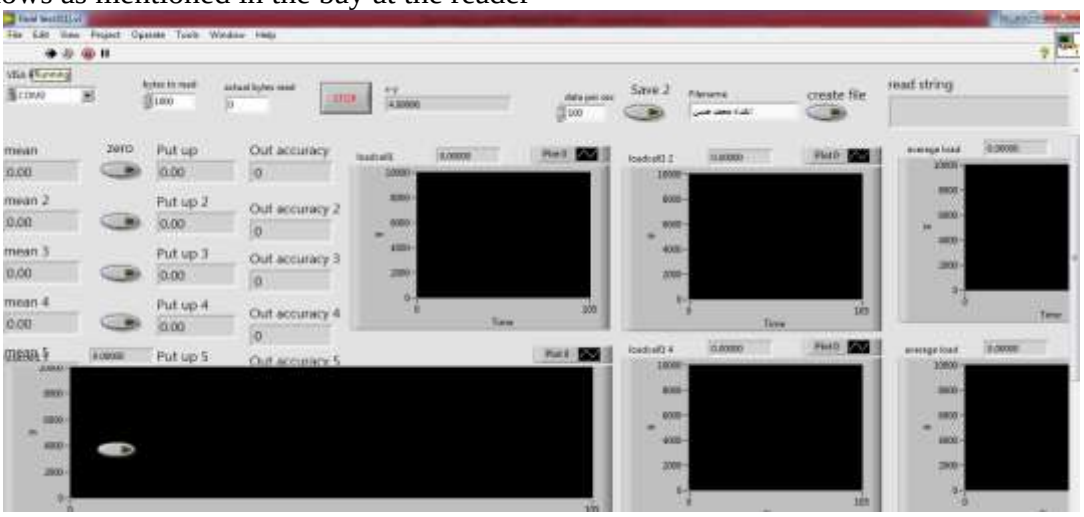

Figure 6 program interface

Accessories with jammers: bolts with samples to install the cube support with the main heckle of the pistons and according to the desire of the runner, i.e. the presence of a spring that raises and lowers the angle of the support according to the position of the foot of the runner and determinants of the base that allow compression stresses and prevent tension during the push and after connecting sensors in the cushions and start trying and doing operating and whistling procedures display the dashboard, signal unit and digital analogue converter panel to digital It is obtained to a laptop to control lab view and data storage and display procedures.

Calibration: Two types of calibration were performed on the two devices, static calibration, and dynamic analysis. For the static state, the calibration process was performed in two steps. In the first step, the four loading cells were calibrated separately to reach their linearity for a certain classification range of applied loads. The second step of the start of the display was performed calibration, loading loads with values up to the legalized load. Five trials were made per pregnancy. The calibration has been repeated. l Cell load excretion per volt (mV/V) as in Figure 7 results in the calibration of the two devices (0 to 2000 N) per load cell separately and the measurement was performed by the two devices by loading the system from zero to 2000 N continuously in steps acceptable to all b clever idea by 3.5%.

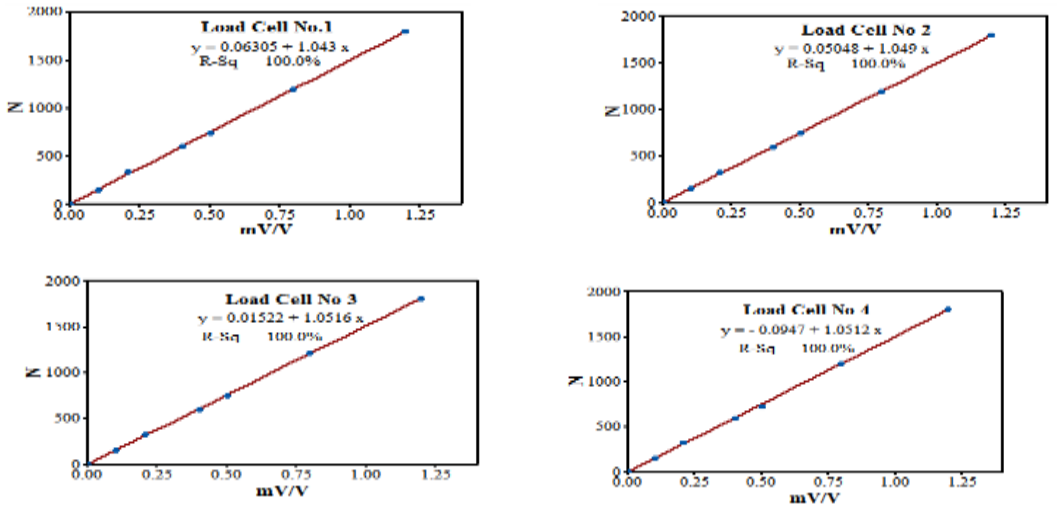

Figure 7 loading cells A dynamic calibration

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was then performed with a CASIO Exilim EX-FH12.5 camera at a speed of 120 frames per second and the Kenova kinetic analysis program to identify the amounts of force propulsion for both feet by deriving the "ma=F" force law by (Al-Fadhli, 2020, p. 27) which states" t^2/MD =F" and compare the results for a 71 kg runner with the designer device and digital values that appeared in the data as in Figure 8, Figure 9 and Figure 10

Figure 8 values time, distances, and instantaneous power on cubes

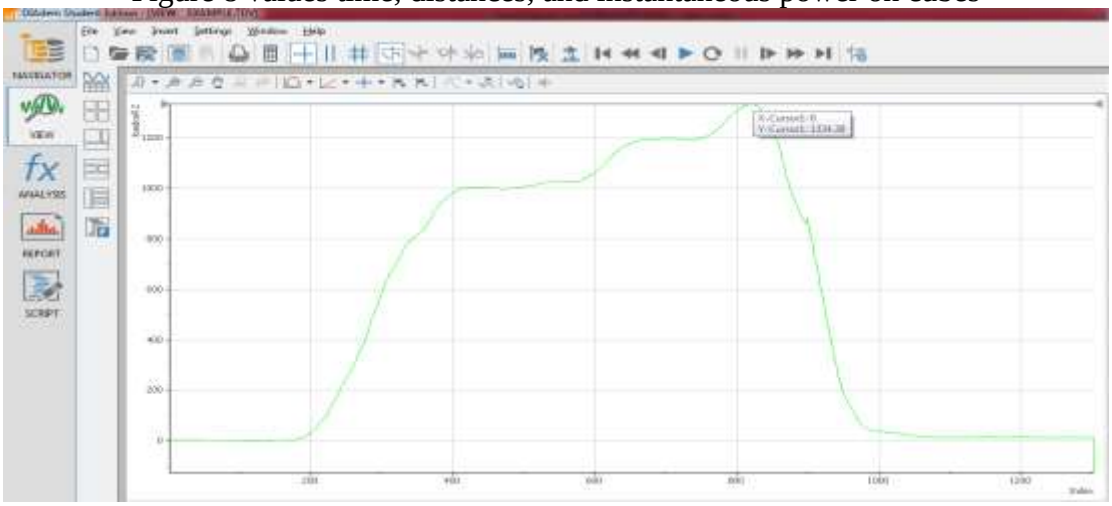

Figure 9 Data Curve

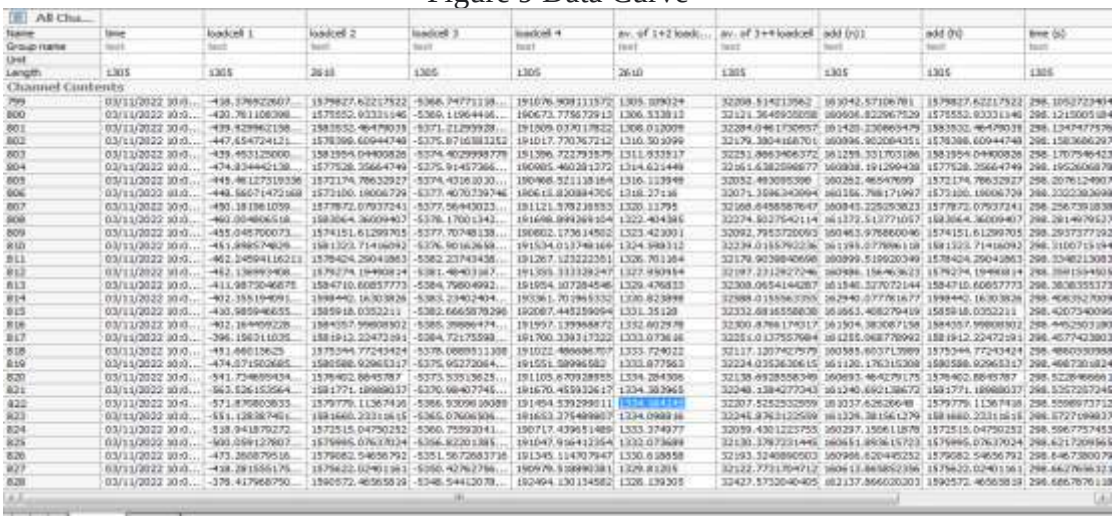

Figure 10 Digital Data Values

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Note that there is an acceptable error rate of 21 N if the payment value through Law N 1355 and what came in reading the device for the same hostility in Figure 8 as the payment value N1334, after which it was calibrated with the device day foot For another enemy of the elite, if the day but was used and several attempts were made on the two designer devices, the results were very close, as in the form that shows the reading of Dayna's foot and the shape (11) which shows the reading of the manufactured device 12.

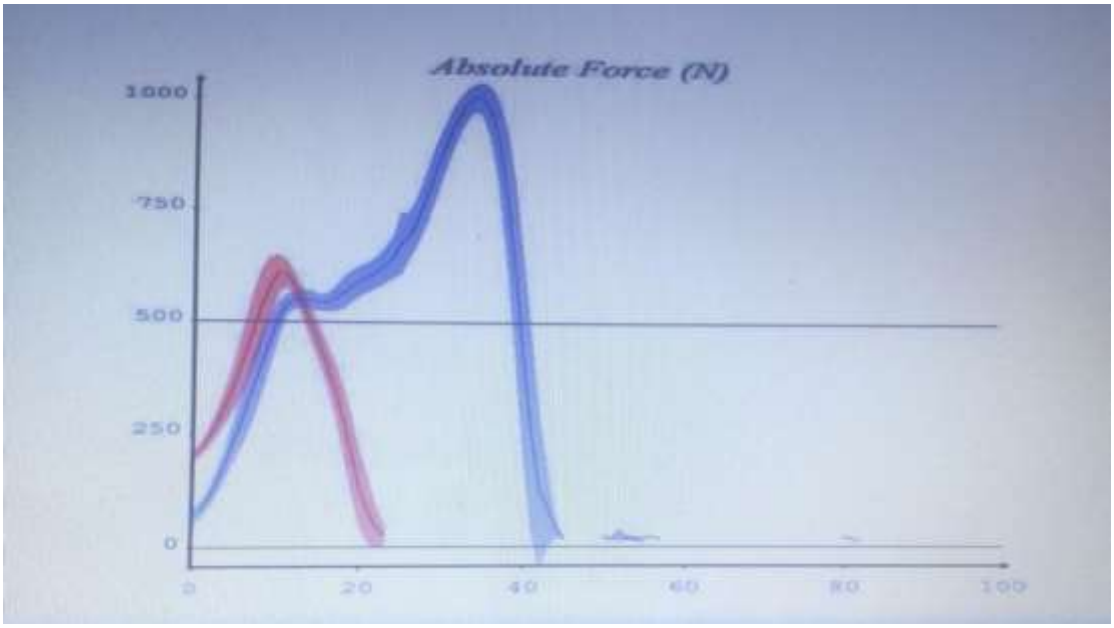

Figure 11 Read the device used

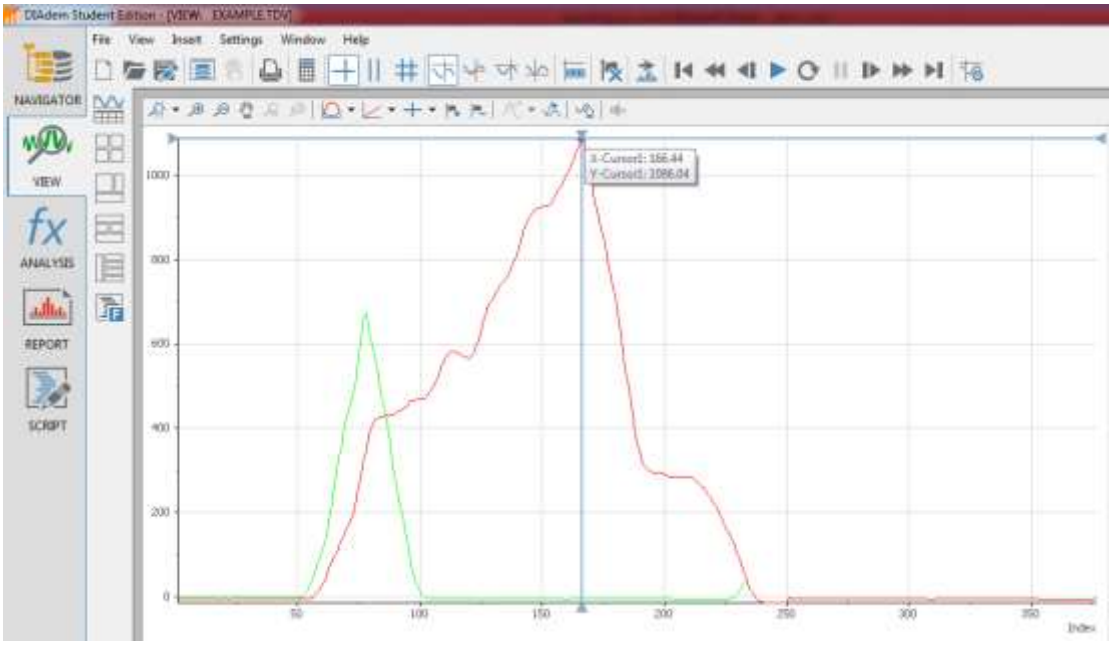

Figure 12 Graphic Curves for Readings

If the results show a convergence of values for the right man, they were in the Dayna foot N 635, but the values for the same man came with the two devices manufactured in N 651 and the results showed the man left in the Dayna foot N 1071 devices and the results in the two devices manufactured for the same man N 1086 and a time of reaction of 0.166 that and that the differences between the two readings are very acceptable.

مجلة التربية الرياضية – المجلد (35) – العدد (1) – 2023. مجلة ذات وصول حر
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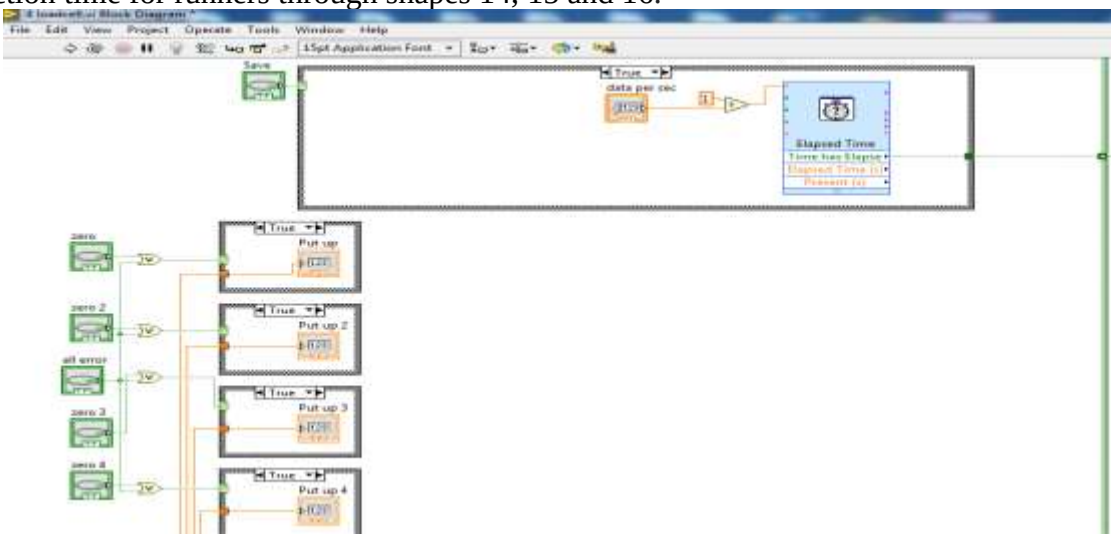
Results

Participants from elite runners representing the Iraqi National Athletics Team were selected in the 100m events, and the test was conducted by releasing each of the two runners to provide two manufactured devices if four starts were made in each launch of the runners racing, and the variables researched were extracted by the following followers:

1. After whistling readings the two devices are turned on then the runners take start mode on the two devices as in Figure 13.

Figure 13 Start Experience from proposed cubes

2. Create a file for runners in the program and start recording with the start of the race and obtain the experimental data collected on the recorded activity through Lab view and then the program La view is used to measure and analyze the data to calculate the different parameters of this test of the factors causing the situation from the structural chart of lab view program The designer and computer screen layout of output information through the Excel file list of results of participants in this activity or presentation of DIA deprogram for measured strength results with the time of the participants in the activity and we can obtain a short value for measured strength and reaction time for runners through shapes 14, 15 and 16.



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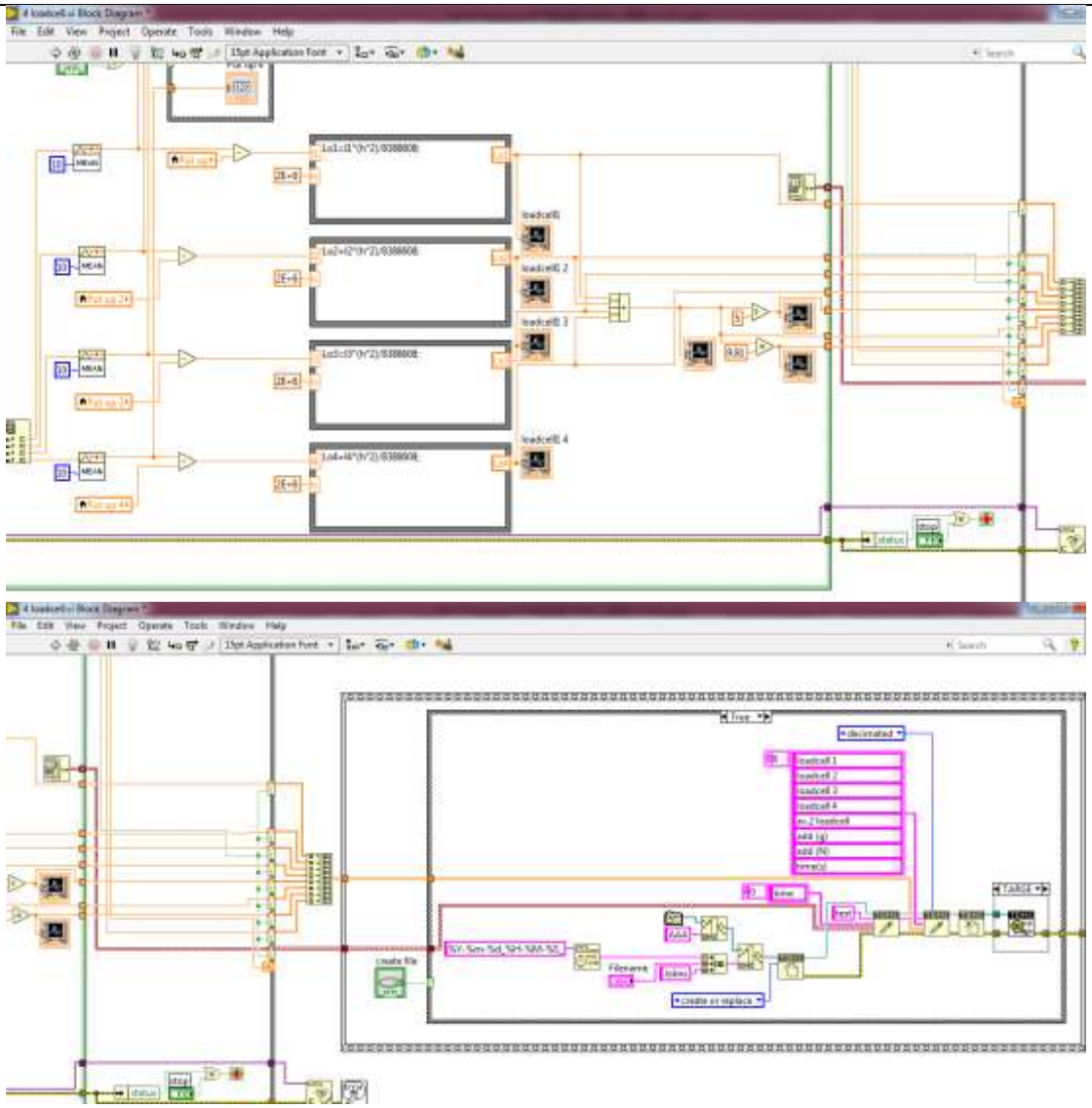

Shapes 14, 15 and 16 force measurements and verb balances

The results came at the best time and for the most important variables calculated by the two devices as follows:

Athlete	Weight		Height (cm)	Reaction Time	The maximal force of rear blocks	The Maximal force of front blocks	TOTAL FORCE (Re &Fr)	BW	Impulse	Total time
	(Kg)	(N)								
#1	75	735	173	0.155s	828N	1423N	2251N	3.062	1904N.s	10.61s
#2	79	774.2	175	0.164s	725N	1176N	1901N	2.455	1608N.s	10.72s
#3	71	695.8	177	0.169s	664N	1109N	1773N	2.55	1372N.s	10.78s
#4	69	676.2	181	0.175s	657N	951N	1609N	2.380	1344N.s	10.75s
#5	76	744.8	182	0.186s	750N	1019N	1769N	2.375	1325N.s	10.83s
#6	78	764.4	179	0.176s	688N	1153N	1841N	2.408	1331N.s	11.25s
#7	65	637	175	0.161s	650N	925N	1575N	2.472	1276N.s	11.30s
#8	68	666.4	176	0.177s	674N	1087N	1761N	2.642	1323N.s	11.50s

The variables calculated by the two devices show the amounts of momentary force exerted by the back foot and the front (on the front and rear start cubes) (newton), as well as the reaction time (milliseconds) as well as the value of momentary payment

(**Impulse**) (Newton. Second), and the total time of the competition, as these results are consistent with what is required of the actions of the participants to perform the maximum effort in a brief period, by giving a signal that the designer platform is consistent with the results of the experiment in an activity period.

discussion

The preliminary results of the yen performance evaluation device show that most runners are somewhat similar in most variables although there is a slight variation in the values of these variables, which are attributable to differences in the weights of the sample members, as it makes sense to shed momentary momentum in the starting stage of the run-up from three times to less than two and a half times (BW) as shown by the results of the table above (Racic & Pavic, A Stochastic approach to modeling quasi-periodic jump force signals, 2010, p. 3040). This means that the total effort of the momentary forces on the starting cubes is consistent with the weight of each rider (Racic, Brownjohn, & Pavic, Reproduction and application of human bouncing and jumping forces from visual marker data, 2010, p. 3409), as it appears that the second best momentary push to BW was the eighth runner who achieved the final driving time capacity (s11.50) compared to the first runner who achieved a time (s10.61) when exerting the equivalent of (3.062) strength of (BW) leading to high-capacity thrusts.

The implementation of these tasks with the two proposed devices is of great importance to monitor the improvement of strength by men against the total body mass (or weight) and to help achieve success in the later stages after launch and success, as the evaluation of the work of the muscles in the two organs can indicate the amounts of strength when performing a similar physical effort such as running, jumping, throwing and even walking quickly, which requires all of them Use the force on the ground. As well as helping to learn how to use horizontal power, especially when starting (undermann, Corazza, & Andriacchi, 2006, p. 243).

The use of this technique and sensors is of great importance for the development of strength and indicators, which may be the addition of non-linear analyses and bandwidth is a useful option of great importance, which can be added in training programs based on kinetic analysis because the information from sensors plays a major role in improving the sense of strength and making the necessary corrections when sitting on cubes and starting (Kuo, Donelan, & Ruina, 2005, p. 91).

Given the close levels of runners, the factor of muscle mass, training age and experience can play an important role in the strong start and we note that the results of the reaction time were close between the first place holder and the eighth place holder in addition to the maximum strength of the right man and the left man was of varying effect in the final achievement, as for the payment of power, it seems that most runners achieve a close rate, which makes the payment amounts look appropriate and converging and that the final achievement was achieved through Compensation is in the stage of acceleration and maximum speed (Doke, Donelan, & Kuo, 2007, p. 2399) It is the production of a quick movement of the arm, then the torso, the hip, and the push of the hind leg, then it will be more forceful than the hind leg, which launch first, and then the start is performed at the highest speed. (Ahmed, 2020, pp. 86-92) The increase in acceleration comes from more forward inclination of the upper limbs when launching, which indicates that the forward inclination position at this stage is important to enhance sprint speed (Abdulricha,

2020, pp. 102-112) Achieving achievement and obtaining a high level in athletics activities does not come through the use of the best scientific methods in sports training only, but also as a result of the proper use of modern measurements and tests and scientific planning accompanied by the results of tests related to the laws of movement and their practical application in training (Ajil, 2020, pp. 90-94). It is important to remember one essential thing: when the starting cubes are used in this device, it must determine where the cubes are placed to suit the position of the body and allow the rider to accelerate, as the design of the starting cubes to give runners a great horizontal momentary force while achieving the best angles in the body parts give the best determination of the forces of the moment of departure from squatting mode (Hughes, Clark, & Klenerman, 1990, p. 249).

The bottom line: The starting cubes are part of a starting pad that will be used in the sport of speed racing by athletes to strengthen their feet at the beginning of the race so as not to slip and exert the greatest horizontal power as they advance when they hear a beginner's gun.

A new aspect was introduced and the use of two support devices started with sensors - kinetic, and the two devices were designed in the form of legal cubes for competition and to measure and analyze other standards and standards. More research work such as sports sensitivity, improved accuracy and algorithms should be considered to achieve better results for athletes.

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APPENDICES

IQ (19)
جمهورية العراق
وزارة التخطيط
الجهاز المركزي للتقييس والسيطرة النوعية

(12) اللغة العربية

(13) بـــراءة اختـــــراع

(11) رقم البراءة: 7832
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(30) تاريخ طلب الأسبقية:
(33) بلد الأسبقية:
(31) رقم طلب الأسبقية:
(11) تاريخ منح البراءة: 2023/1/26

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(73) اسم صاحب البراءة: الـــــذوات اعـــــلاه

(74)اسم الوكيل :

(54) تسمية الاختراع:
مساند بداية الركض بمستشعرات حس – حركية .

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