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Body Motion Sensor

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Abstract: In this research, the concept of the body motion sanser was studied, the body motion sensor, and its importance in daily scientific life.

And the simplest of its types, such as extremism, is one of the most important scientific applications and its usefulness, which can help a lot when applying it.

1. THEORITICAL APPROACH

1.1. INTRODUCTION

Wearable motion sensors have been used in high-impact applications such as activity recognition, health, quality sensing, and elderly care. As a result of its popularity, a lot of work has been done to improve the power consumption of these sensors*6* the sensor can be reliable.

Feeling of movement on other parts of the body, even when the sensor itself is quite static, providing the possibility-Not provided by accelerometers or other inertial sensors.

In the past decade, many human motion analysis tools have been successfully developed. However, optimizing mobile and unobtrusive sensor systems remains a challenge. To monitor and investigate human movement well, wearable electronic devices including pressure and angle sensors that record information from rotational and sliding joints are essential for reliable position recognition. 7, a new solution has been introduced to solve the problems of fabric-based wearable sensor systems. 8 -10 Compared with traditional measuring systems, soft fabric based sensor systems have the advantages of low cost, light weight, flexibility and good adaptability to different body structures. 1112 Textile materials including fabrics, yarns and fibers are a promising new version of silicon chips in wearable electronic devices. More recently, electronic textiles (e-textiles), generally known as smart textiles or smart fabrics, refer to smart materials or systems that sense and respond to the surrounding environment in a predictable manner. 13 They have attracted tremendous interests due to their wide applications in the fields of flexible electronics, including health monitoring, human motion detection, and intelligent robotics.

This mini-review focuses on the summary of technologies for functional-specific smart textile developments, with an emphasis on stress sensors for human motion detection. The functions of smart textiles can be categorized into sensing, actuation, and adaptation behaviors, which are performed by attaching an additional electronic component to the textile or part of the fabric structure itself. 14 Electronic component integration based on the fabric structure itself, that is, conductive or metal-coated filaments, is defined as fabric-based. 15For a fabric-based sensor, instead of simply mounting the sensor on the fabric material, the sensor is part of the fabric structure and vice versa. Accordingly, textile materials are manufactured for use as sensors, actuators, and/or other types of transducer where in our current project, paper was adopted as an alternative to prior studies (textiles, smart fabrics) and tested as a human motion sensor.

1.2. What is polymer?

Polymers are one of the most important materials found in nature, but because of the high cost of extracting them from nature, industrial polymers have been made, as polymers are: ***Polymers know***

Polymers are a substance that consists of a large number of molecules linked together in a unique way similar to chains, and polymers exist in nature in both natural and industrial forms, where natural polymers such as rubber and wood consist of simple hydrocarbons, while industrial polymers consist of the integration and interaction of several monomers through various chemical reactions such as Plastics, and polymers are found naturally in the cells of the human body, such as proteins, which consist of the union of amino acids and nucleic acids.[3]

1.2.1. Classifications of Polymer:

Most polymers, especially industrial ones, have the property of plasticity, especially with heat, and this means that when they are heated, they can be recycled and formed many times in addition to enjoying other properties, including: [1]

1_ Resistance to chemicals: This feature is noted in plastic containers that contain cleaning materials, as they are highly resistant to chemicals that may cause great damage when in contact with human skin.

2_ Electrical and thermal insulation: Polymers are used in the manufacture of handles for cooking utensils due to their being an excellent thermal insulator, in addition to their use in covering electrical wires due to the fact that they do not conduct electricity through them.

3_ Lightweight: Polymers are considered lightweight materials compared to the strength they enjoy, and this is evident when compared to other materials such as copper, stones and many others.

**_It has several shapes and colors. There are no limits for things that may be made of polymers, as some car bodies, wool and rayon, polystyrene and soft drink bottles are made from them.

**_ Their use in the medical industries Polymers are used to make vessels to save blood from damage, and they also play an important role in making tubes through which oxygen is passed without burning it, in addition to relying on medical devices such as dialysis devices in making their tubes.

1.2.2. Example of polymer

There are many examples of polymers in daily life, whether they are natural or synthetic, including: [2]

1. plastic.
2. rubber.
3. DNA.
4. Children's paste.
5. The cellulose found in leaves and trees.
6. Proteins such as hair and nails

1.2.2. (A) polymer (PVA):

Polyvinyl alcohol (PVA) is a granular, white, odorless polymer. It has the ability to Soluble in water, it dissolves slowly at room temperature or cold water, but it dissolves faster with temperatures high when heated. It is used in the manufacture of paper and textiles, and its fibers are used to reinforce concrete, as well as the manufacture of gloves Chemical resistant protector.

Advantages of conductive polymer
1. Easy and low cost of manufacturing.
2. Ease of access to and handling of the material.
3. It is included in many electrical materials and their insulators

1.2.2. (B) Black carbon powder:

Carbon black

It is a form of amorphous carbon with a high surface area to volume ratio, and therefore it is one of the first nanomaterials to find common uses, despite its low surface area to volume ratio compared

to activated carbon. It is similar to soot but with a much higher surface area to volume ratio. Carbon black is used as a pigment and as a hardener in rubber and plastic products. It is used exclusively or in combination to provide powerful sensors or multifunctional materials on the other hand [11, 12]. The most common use [70%] of carbon black is as a pigment and a reinforcing phase in automobile tires. Carbon black also helps conduct heat. Charcoal is used in medicine in the form of tablets or powder to absorb toxic substances from the digestive system.

1.3. What is sanser?

A sensor is a device that receives a signal or stimulus and responds to the stimulus in the form of an electrical signal. The output signals correspond to some forms of electrical signal, such as current or voltage. The sensor is a device that receives Different kinds of signal i.e. physical, chemical or biological signal and converts them into an electric signal. The sensors are classified into different types based on the applications, input signal, and conversion mechanism, material used in sensor characteristics such as cost, accuracy or range. This chapter presents an overview of sensors and their classifications as thermal, magnetic optical, mechanical and chemical. The transfer functions, characteristics and specifications are also discussed with introduction to basic forms of sensors.

Introduction

We can find sensors everywhere, and the whole world is full of sensors and their Applications. There are many types of sensors available around us, in our offices, Gardens, shopping malls, homes etc. a sensor is a device which receives signals as well as responding to a Signal or stimulus. The stimulus signals can be defied by the measure, property, or state which is sensed. We also can say that a sensor is a translator that converts a nonelectrical value to an electrical value [1–3]. The output signal of a sensor may be in the form of voltage, current, or charge. A sensor has many forms of input properties and electrical output properties. If there is small change in the sensed quantity, it will cause a small change in the electrical output and the changes can be detected with their measuring capabilities.

All the sensors are categorized on the basis of their uses, applications, material Used and some production technologies.

1.3.1. Types of sensors

There are many sensors commonly used in various applications [1, 11–21]. All these sensors are categorized as per their physical properties like temperature, resistance, pressure, heat flow etc. The following is a brief discussion on different types of sensors.

1_Temperature sensors

A temperature sensor is used to measure the amount of energy in the form of heat And cold produced by an object and system. It allows one to sense or detect any physical change to that energy and gives the output as analog or digital. Temperature sensors are used in various applications such as notification of environmental temperature, medical instruments, automobiles etc. According to Application and its characteristics.

2_Position sensors

The position sensor detects the position of an object either linearly or in rotation With respect to some fixed point or position. Position can be determined by the Distance between two points moving away from some fixed points. We can measure the displacement of position in a straight line by linear sensor and angular displacement using rotational sensors. Position sensors are also known as potentiometers and used to measure the displacement of the object.

3_ Infrared sensor

An infrared (IR) sensor consists of two packs, one is Rx (receiver) and the other is TX (transmitter). Transmitters are used in transmitting the rays in the infrared spectrum and the receiver receives the IR spectrum range. In the IR spectrum, the voltage is given between its terminals and then it emits rays. The main principle of working of an IR sensor is reflectivity by an object. When an object is

placed in front of the transmitter it tends to reflect the rays that are coming from the IR sensor back to the IR sensor.

4_Touch sensor

Touch sensors are sensitive to touch, pressure and force. The sensors operate as

Switches and when the surface of the sensor is touched the current starts to flow in the circuit just like current flowing in a closed circuit. When there is no contact, it performs like an open circuit and no flow of current is reported. There are two types of touch sensors, capacitive and resistive. The touch sensors are used popularly in modern gadgets such as smartphones, and other handy devices**.**

1.3.2. Application characteristics

Sensors are not generally designed for general purpose and are application oriented. Sensors are required according to applications of different types of sensors such as: speed sensor for synchronizing the speed of multiple motors; temperature sensor used for controlling the temperature; ultrasonic sensor for measuring the distance, etc.

2. PRECTICAL APPROACH

2.1. Equipment's needed:

A. Distilled water.

1. Polymer (PVA).
2. Black carbon powder.
3. Spatula
4. Glass beaker.
5. Magnetic stirrer.
6. Sensitive scale.
7. Paper type (A4).
8. Magnetic capsule.
9. The electrical system consist of a laptop with a soft ware operating system , electrodes and a keithley 2401 source meter.

2.2. procedure:

Action steps, first of all. We prepared all the required equipment and as a first step of the experiment, we weighed the polymer (PVA) using the clear sensitive scale No. (1)

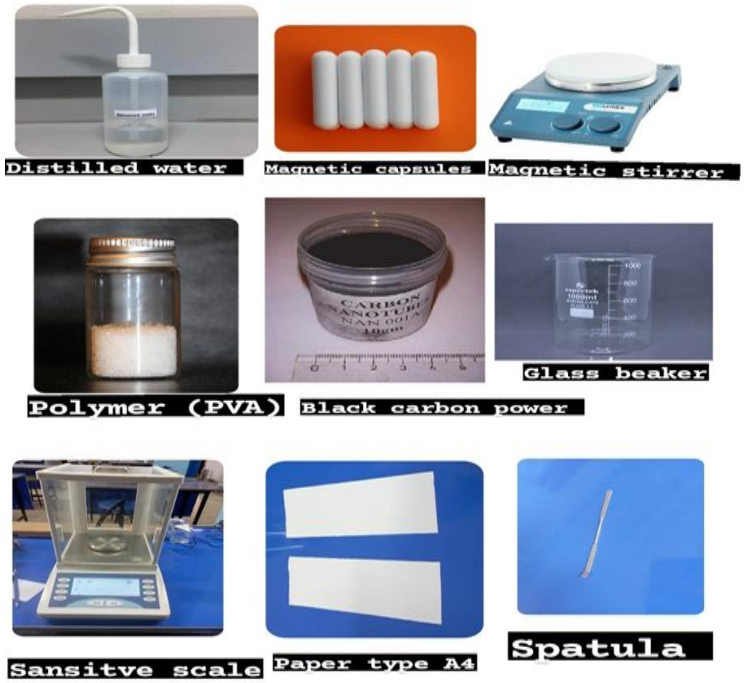

Fig (1)

With a weight of 2.5g and then we made sure that the glass beaker was clean and we added the magnetic capsule inside it and put about 50ml of distilled water inside it. And put it on the magnetic vibrator device and adjust each of the heat to a temperature between 70-80 degrees Celsius and adjust the speed on a scale between rmp 500-700, then after the device is set, the polymer is gradually and slowly placed in order to mix well as in Figure No. (2)

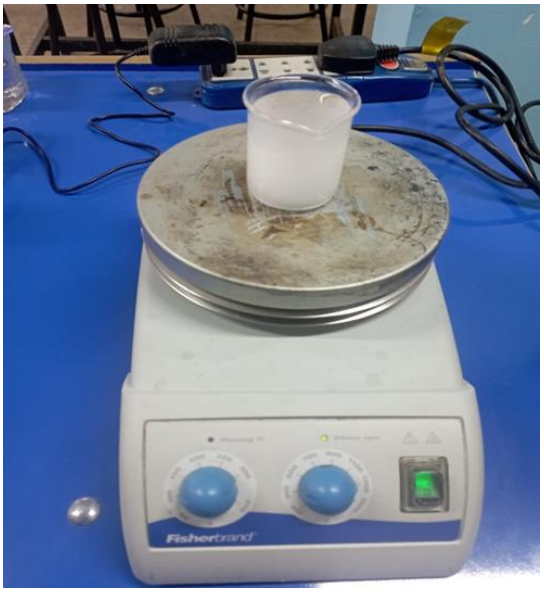

Fig (2)

As the nature of the polymer used in the form of granules, it turns by good mixing and heat into a viscous substance, and this is what is required as an initial step. When we notice the beginning of the transformation of the polymer into a viscous substance, we start by increasing the speed until the substance becomes transparent and has a noticeable viscosity. The question that arises in this paragraph is why the magnetic capsule was placed inside the glass beaker? As an answer to this question, the device used has a magnetic property and that the magnetic capsule will attract with the device and do a good mixing of the materials placed inside the glass beaker instead of mixing materials by hand and spending longer time and unsatisfactory results. Between magnetic and non-repulsion when placed on the tip and lead to material volatilization from the glass beaker or magnetic capsule volatilization as a result of high speed and magnetic repulsion that may occur. Then, after mixing the polymer well, a certain amount of carbon is placed and it mixes well with the polymer. As in Figure **(3),**

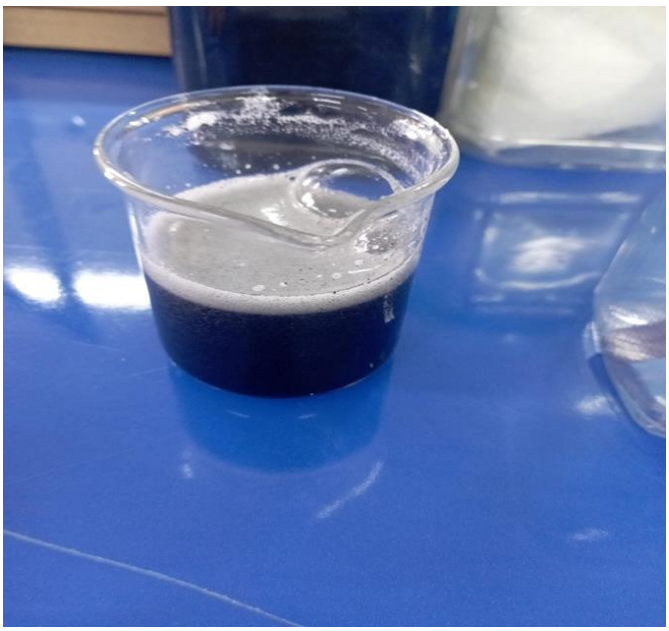

Fig (3)

Then we prepare pieces of A4 paper and paint the paper with the previously prepared material, so that the paint is well and away from the edges of the paper. After that, we prepare the system. Connecting the electrodes to the coated paper and fixing it well as in Figure (4),

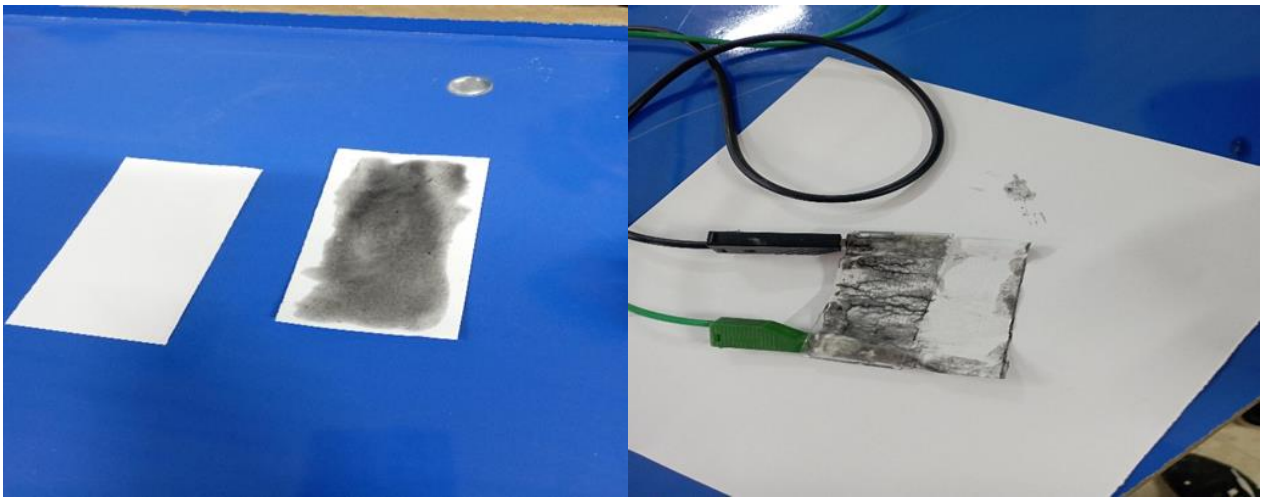

fig (4)

then adjusting the voltage of the keithley 2401source meter 9vb and a constant current, then we set a variable voltage and a constant current of 0.01A, so the voltage has changed with time according to the relationship R=I/V. Then we put the paper after connecting the electrodes are on them on the finger of the hand, or we hold them in the hand and begin to fold them. We notice that an electrical signal from the computer has begun to appear, indicating that the materials are well connected. Then we bend the paper and return it straight, and here appears what is called response time, which is the response time. It is the time for a system or functional unit that takes to respond to Specific input when we quickly fold a paper. And when you open the paper quickly after bending it. The recovery time is shown which is, in general, the recovery time is defined as the time that the sensor returns to the base value after removing the step of the measured variable. It is usually defined as the time to decrease to 10% of the final value after removing the step of the measured variable. After that we perform Repeatability.

Repeatability which is a measure of a method's ability to generate similar results for multiple preparations of the same sample. Provided that it be of the same degree of force of opening and closing the paper, and therefore to

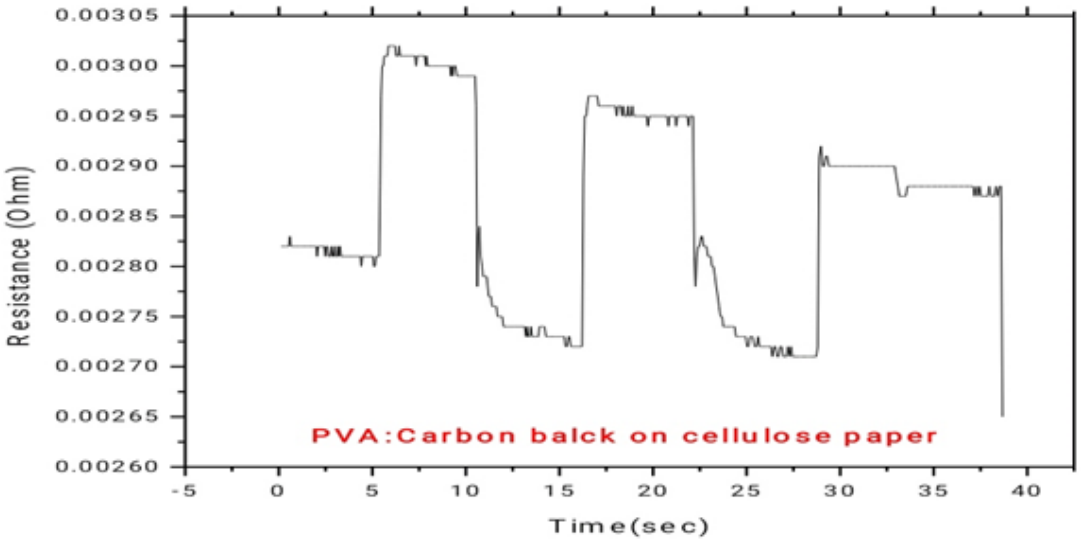

Fig5

Obtain better results, we notice from the recurrence of irregularity of the result due to the irregularity of response with recovery, where the fewer were, the better the results and the appearance of a regular curve as in Figure (5).

2.3. Experiment accounts:

We using ohm low:

R=V/I

Where:

R=Resistant masseur by ohm.

V= voltage masseur by volt (v).

I=Current masseur by Amber (A).

Where first think make voltage constant at 9v.

And after make current constant at 0.01

Time(sec)	Current(Amber)	Resistance (ohm)
2.608	3.13E-04	2.82E-03
2.665	3.13E-04	2.81E-03
2.715	3.13E-04	2.81E-03
2.765	3.13E-04	2.81E-03
2.821	3.13E-04	2.82E-03
2.878	3.13E-04	2.81E-03
2.939	3.13E-04	2.81E-03
3.041	3.13E-04	2.81E-03
3.111	3.13E-04	2.81E-03
3.162	3.13E-04	2.82E-03

3. Discussion

3.1. Experiment goal:

This research has been specially selected and not others for its usefulness in helping people who are unable to move, i.e., the semi-disability (**meaning who can move a finger or toe or any part and is unable to move the whole body**), where what our research does is to use the simplest materials such as paper to show the quality of work In using the simplest things to do something meaningful for the public, Where we dealt in our research with the concept of polymer and the use of its simplest types (**black carbon and pva)**, as well as different types of sensors to ensure the quality of work.

3.2. Practical part results:

After connecting the poles in the system, we installed the voltage at (9v) through the Keithely 2401souce device.

We made a variable current, and then we made the voltage variable and the current constant (0.01A.) whereby Ohm's law R = VI we drew a curve representing the relationship between resistance and time. It turns out that the longer the recovery time. And responded time a little was better, because the irregular spread of the resulting wave is a result of the irregular movement of the finger with time, so it became a disparity in the results, so the more regular the movement of the finger with a certain time, the wave became regular and perfect and in the form of (5) represents the best regular resulting wave.

3.3. Benefit of the project:

The main objective of the project is remote patient monitoring, Personal health care service, especially monitoring of daily activities [89]. Persons experiencing a sudden decrease in physical activities require special and/or immediate attention, even if the decrease is not recognized by the persons themselves. For example, deterioration of chronic diseases such as chronic heart failure, diabetes and Alzheimer's disease is usually associated with decreased activities [90]. Wearable

motion sensors carried by the patient can transmit information about reduced physical activities in time through a network of wireless sensors to help the clinician in charge reach a treatment decision.

3.4. Applications on a project:

Among the most important applications similar to what we are talking about are: The use of motion sensors to measure the intensity of physical activities, and thus energy consumption during exercise. For example, acceleration and oxygen consumption during treadmill walking and stair walking have been successfully linked in a recent study [86]. The sports activities of patients with chronic heart failure are monitored using a pedometer, which is a conventional scale inertial sensor with a working principle similar to a solid-state accelerometer but only counts the steps a person has walked [87]. Furthermore, the use of a network of solid-state sensors can be identified, different activity types, posture, and gait, which can provide a comprehensive measure of energy expenditure [88]. When combined with other types of sensors, for example, thermal sensors to monitor body temperature and pressure sensor to monitor blood pressure, these sensors are expected to provide a better estimate of energy expenditure and metabolic work, thus contributing significantly to rehabilitation.

The Reference:

1. Wang, C., Chen, C., Wen, K. A monolithic CMOS MEMS accelerometer with chopper correlated double sampling readout circuit. IEEE ISCAS 2011, 2023-26.
2. S. Majumder, T. Mandal, M. J. Deen, Sensors (Basel) 2017, 17, 130.
3. H. Lopez-Nava, A. Munoz-Melendez, IEEE Sens. J. 2016, 16, 7821.
4. H. Lim ،E. Vats ،CS Chan 1773 ، 48 ، 2015 .التعرف على الأنماط ، .
5. H. Kainz ،CP Carty ،L. Modenese ،RN Boyd ،DG Lloyd ،Clin. ، 30 ، 2015 .التكنولوجيا الحيوية 319.
6. Shahroudy, J. Liu, T. T. Ng, G. Wang, NTU RGB plus D: a large scale dataset for 3D human activity analysis. Proc Cvpr IEEE 2016, 1010–1019.
7. H. Y. Zhou, H. S. Hu, Biomed. Signal Proces. Control 2008, 3(1), 1.
8. B. Sieberg, A. Smith, M. White, J. Manganella, N. Sethna, D. E. Logan, J. Pediatr. Psychol. 2017, 42, 52.
9. G. Frazzitta, R. Maestri, G. Bertotti, G. Riboldazzi, N. Boveri, M. Perini, D. Uccellini, M. Turla, C. Comi, G. Pezzoli, M. F. Ghilardi, Neurorehabil. Neural. Repair 2015, 29, 123.
10. Majumder, T. Mondal, M. J. Deen, Sensors (Basel) 2017, 17, 130.
11. H. Lopez-Nava, A. Munoz-Melendez, IEEE Sens. J. 2016, 16, 7821.
12. F. Attal, S. Mohammed, M. Dedabrishvili, F. Chamroukhi, L. Oukhellou, Y. Amirat, Sensors 2015, 15, 31314.
13. M. M. Rodgers, V. M. Pai, R. S. Conroy, IEEE Sens. J. 2015, 15, 3119.
14. J. Lee, H. Kwon, J. Seo, S. Shin, J. H. Koo, C. Pang, S. Son, J. H. Kim, Y. H. Jang, D. E. Kim, T. Lee, Adv. Mater. 2015, 27, 2433.
15. R. Paradiso, G. Loriga, N. Taccini, IEEE Trans. Inf. Technol. Biomed. 2005, 9, 337.
16. M. Schwartz, Encyclopaedia of Smart Materials, Wiley, New York 2002.
17. X. Tao, in Smart Fibres, Fabrics and Clothing (Ed.: X. Tao), Woodhead Publishing, Cambridge, UK 2001, Ch.1, pp. 1–
18. P. Bosowski, M. Hoerr, V. Mecnika, T. Gries, S. Jockenhövel, in Electronic Textiles (Ed.: T. Dias), Woodhead Publishing, Oxford, UK 2015, Ch.4, pp. 75–107

19. "The Basics: Polymer Definition and Properties", plastics.americanchemistry.com, Retrieved 13-7-2018. Edited. ↑ Anne Marie Helmenstine (11-7-2018),
20. What Are Some Examples of Polymers?" ،ww.thoughtco.com, Retrieved 13-7-2018. Edited. ↑ Alina Bradford (13-10-2017),
21. "What Is a Polymer?" ،www.livescience.com, Retrieved 13-7-2018. Edited.
22. Delhaes, P. (2001). Graphite and Precursors. CRC Press. ISBN 90-5699-228-7.
23. هيام بيرقدار. "الكربون". الموسوعة العربية. تحولات الجرافيت في درجات الحرارة العالية والضغط العالي وتم حثه بإمتصاص شعاع
24. Copyright (c) Heibonsha Limited, Publishers, Tokyo. All rights reserved
25. Fraden J 1997 Handbook of Modern Sensors: Physics, Designs and Applications 2nd edn (College Park, MD: AIP Press)
26. Boles T T 2012 Comparing piezoelectric and piezoresistive accelerometers J. Sensors 7 34–5
27. Fraden J 2016 Sensor characteristics Handbook of Modern Sensors (Cham: Springer) https://
28. Khijwania S K, Srinivasan K L and Singh J P 2005 Performance optimized optical fiber sensor for humidity measurement Opt. Eng. 44 034401
29. GE ،Intel Jointly Eye Home Health
30. Ruuskanen JM ،Ruoppila I. 84 إلى 65 النشاط البدني والرفاهية النفسية بين الأشخاص الذين تتراوح أعمارهم بين عامًا. شيخوخة العمر. 1995 ؛ 24 : 292 - 296. [PubMed]
31. Slootmaker SM ،Chin A ،Paw MJ ،Schuit AJ ،van Mechelen W. ،Koppes LL الصلاحية المتزامنة باستخدام استهلاك الأكسجين كمرجع. سكاند. جيه ميد. علوم. MTI Actigraph المرتبط بـ PAM لمقياس التسارع رياضة. 2010 ؛ 19 : 36-43. [PubMed].
32. Jehn M. ،Schmidt-Trucksass A. ،Schuster T. ،Hanssen H. ،Halle M. ،Kohler F. Pedometer Accuracy in المرضى الذين يعانون من قصور القلب المزمن. كثافة العمليات الرياضة. ميد. 2010 ؛ 31 : 186 - J. 191. [PubMed].
33. أندرو جي دبليو ، ديفيد في تي ، ألان جي إتش ، كريستوفر جي جي ، ديفيد بي بي ، دانيال إيه جيه قياس إنفاق الطاقة في الرياضيين النخبة باستخدام مقاييس التسارع ثلاثية المحاور المستندة إلى MEMS. IEEE Sens. J. 2007 -481 : 7 ؛ 488