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Investigating and Checking the Javelin Athlete's Movement Parameters Using Smart WSN

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***Abstract*—Javelin is the well-defined path and field experience available from the human race source. Since the human race has grown, throwing the javelin has been included in sports. This paper proposes investigating and checking the javelin athlete's movement parameters using a smart Wireless Sensor Network (WSN). This approach aims to design a smart WSN for giving the athlete status based on frequent and examining the movement parameters. Here, measure the javelin movement's parameters like distance, height, speed, and angle of the javelin release. The athlete's ranks are kept in the cloud database, demonstrated via the Smartphone app. The feedback about the status of the athlete is given through mail. This status brings timely attention as athletes go for their daily training and assist athletes or coaches in recognizing covering of distance or performance, which may bring about problems as earlier as probable. The device's low cost takes the greater alarm to more sports person and coaches.**

Keywords—Javelin athlete's movement parameters, Wireless Sensor Network, Smartphone app, Cloud Server, Sensor.

I. INTRODUCTION

WSN is famous in several fields, such as forecasting weather, smart agriculture, observing real-time athletes, health care, etc. [1]. For smart work, WSN has been concerned with online observing athletes and offering [2]. Sports wounds discuss several damages that occur during the process of sports training. The wound parts are directly associated with the sports training obtained by moving athletes [3]. The scars of javelin throwers typically happen in the elbow.

To a great extent, the sources of athletes' sports wounds are triggered by inadequate training levels, incorrect movements, and the absence of protection awareness [4]. An actual coaching result can be managed via valuable and appropriate reactions to the athlete's objective function faults [5]. Laboratory-based testing using magneto-inertial sensors, which can detect the absence of function delay and are not restricted by location, is a practice that is becoming less common and more old-fashioned.

An Internet of Things framework for next-generation racket sports training approach to validate its performance [6]. A wearable sensing device established on micro electromechanical systems motion sensors applied to distinguish different badminton strokes and categorize skill levels from different badminton players. It admits a customized sensor node for data gathering, a mobile app, and a cloud-based data processing unit. Nowadays wearable have suit a game changer in sports behavior [7]. Wearable sensors manipulate the game in chasing and observing the function of the player. These sensor assist to link the gap among technology and user. In addition, it contributes a comprehensive analysis of the player to progress his skills and obtain real time feedback that would advantage himself and his trainer.

Human viewers must concentrate on helpfulness to view several events even [8]. A viewer can choose to switch between events for many reasons intuitively. For example, the current view is not appealing. The selected athletes are not influential as expected since detailed event incidents. Javelin throwing is complex motion of speed and force with translation and multi-axis rotation [9]. It is extremely significant for athletes to master the javelin throwing knowledge. The coordinated development of technology, speed and force is the origin for its uninterrupted enhancement.

II. RELATED WORKS

Along with the application necessities of sports training, it contains an embedded information collection, and a database server is intended to apply WSN technology [10]. The hardware is planned with sensor nodes and gathers real-time athletes' movement parameters [11]. The physical and biological gauges application in athlete training and opposition part takes to develop a hot study topic [12]. Both coaches and technical investigators hope to utilize measurable physical and chemical indicators to review the weakness, load, and athlete's repossession in training [13]. They also monitor athletes in training struggles methodically, enhance sports function, and minimize wounds.

Monitor and manage Database approach is majorly focused on javelin throw, trail, and field events. Because of insufficient preparation and a lack of competent trainers, javelin competitors do not do well in the Olympic competition [14]. Javelin athletes have to equate both physical as well as parameters of movement to attain the highest distance when throwing the spear. Develop a function observing system that examines the procedure and content of observing [15]. This study describes the approaches often applied to investigate athlete-watching information to simplify and notify decision-making procedures.

Supporting an efficient athlete observing method is the capability of practitioners to transmit and exist significant details to coaches, eventually outcome in improved athletic function [16]. Developments of an athlete's performance system can primarily distinguish overtraining issues during training actions [17]. These issues can distress athletes' physical and emotional situations, also minimizing their function [18]. Maximum heart rate represents the restricted athlete's heart rate. It is frequently applied to distinguish and avoid overtraining athletes and coaches. Sports injury rehabilitation intervention algorithm introduces a sports injury prediction algorithm by visual analysis technology that applies multisource sensors to receive athlete's action data [19]. It uses deep neural networks to forecast injury. Monitoring sensor data offers a perspective and supplies a basis for better use of convolutional neural networks with computer vision technology. Remote monitoring system for Sports injury rehabilitation training introduces the application of WSN in observing procedures [20]. The accuracy of data observing with 9 different degree injury modes set by 1–9 squares in the conventional method is lesser, when the sports injury accuracy of rehabilitation observing by WSN is higher, that can be maintained above 90%.

Present Javelin throwers primarily focus on muscular strength and manage to throw the javelin at long distance with great speed [21]. However, it is a vital for both men and women javelin throwers to efficiently transfer run-up momentum and throwing arm action into vast release speed and to control the release. A vast joint power is seen in spear hurlers are connected with developments of the shoulder and elbow that is the system for lance tossing injure. These factors may be adapted to diminish injury risk lacking affecting the performance to reach maximum throwing distance.

A microcontroller-based athlete sprint speed data acquisition system using the infrared sensor has two elements that perform as initiate and stop, then the signal is transmitted to the Nodemcu microcontroller and represented as a millisecond time variable [22]. The signal is transmit to the user through the cloud hosting server that can be viewed through a Smartphone after the data has been treated.

III. Proposed Method

The proposed approach's vital objective is to sense factors for the Javelin Athletes' movement. The realizing distance thrown in the javelin mainly establishes the following factors Height, angle, and speed. Accordingly, the formula below can compute the entire distance travelled via the javelin.

$$ED = \frac{s\cos\theta}{g}\left[s\sin\theta + \sqrt{s^2\sin^2\theta + 2gh_0}\right] \quad (1)$$

where, ED denotes the javelin traveled entire g represents the Acceleration because of gravity, s indicates the javelin discharge speed, h0 means the javelin is released at Height.

The analyzed results of the Athlete's throwing parameters are transferred over originally an initialize of MQ Telemetry Transport (MQTT) protocol allowing the javelin device to be connected directly to a cloud to store the available data on the Internet. There is no necessity for additional external devices to examine the data. The proposed method structure of IoT based on Javelin Athletes Movement parameters illustrated in Figure 1.

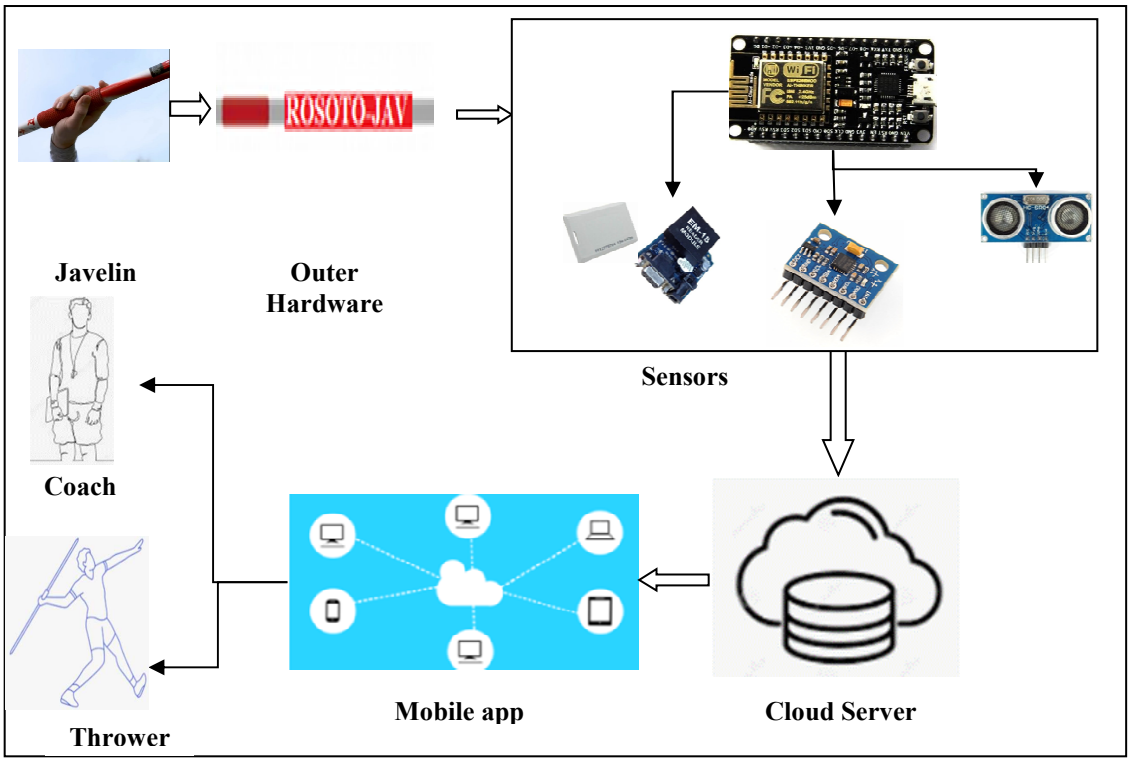

Fig. 1. Structure of IoT based on Javelin Athletes Movement Parameters

Figure 1 demonstrates the three essential components: hardware device, Smartphone app, and cloud server. The hardware device includes the entire sensors and electronics necessary for observing and distinguishing a parameter the

athlete is lagging [23]. The Smartphone app offers the end-user plus a Graphical User Interface (GUI) for keeping the information of the device function from a remote position. The cloud server plays as the distributor between the Smartphone app and hardware device, handling entire information traffic among them in real-time.

A. Sensor Devices

The inertial measurement unit (IMU) consists of a mixture of accelerometers, gyroscopes, and occasionally magnetometers that evaluate the force, angular rate, and sometimes the body enclosed through irresistible regions. Here, the inertial capacity sensor is used to discover two attributes: the angle and the velocity of the javelin. This unit is associated with the serial transmission I2C of the Node multipoint control unit (MCU). Here, the release angle factor information is collected and continued for further procedure. The complete unit is positioned in the javelin centre portion to discover the accurate evaluation for examining and observing the javelin factors.

Radio Frequency Identification (RFID) is associated with the node MCU UART pins. Each athlete is offered the Tags that take a single identity for their identification of name. Beforehand the athletes obtain prepared for the throw. From the cloud database, the tag will be shown on the application of Smartphone's.

Ultrasonic sensors are engaged to find the distance between the objects with the help of sound waves. It is utilized in assessing the javelin release factor height. Additionally, it calculates the distance between the javelin's center and the thrower. In this part of the competition, the athlete is required to hold the javelin, which is used to send ultrasonic waves, and then wait for the waves to return. The node MCU has several features: Wi-Fi enabled, Smart and Simple, Accessible at Small Charge.

A cloud server usually distributes the facilities like databases, storage, analytics, software, and even extra internet features. The server sends the calculated distance. It also sends more information, such as, the athlete's name, angle, height, and speed to the mobile technology, where it may be seen via the app. The following are some of the benefits that the suggested gadget offers:

1. Using Wi-Fi makes it possible for the data to be saved on a safe cloud-based database that can only be accessed by athletes and coaches who have been verified.
2. The circumstances of javelin throwing may be monitored without the coach needing to be close, eliminating the need for the coach to make numerous visits to the throwing area.
3. The coach can access information about the status of the javelin throw athlete, which has been stored in the cloud database via an app or website.
4. The aspects of the javelin throw, such as the angle of release, the height of release, and the speed of release, may be predicted using this tool.
5. The coach and the athlete benefit from its light weight, portability, and continuous monitoring capabilities, allowing them to do away with bulky, cumbersome apparatus.

IV. Result And Discussion

The server provides excellent entrees to the users that are all over the available ability to the athlete and the coach. The server contains storage characteristics established by a database of MySQL. The coach and athletes demand the server to observe and log in from the server and receive consistent outcomes. The athlete and coach present the unique username and PIN to log in.

The software provides information about the athlete to the coach for a time frame. This capability is made available to the coach. By picking the athlete ID, one will be able to examine the comprehensive information of the specific athlete function in the prior registers of full counts. All athlete's information details are wholly displayed by choosing all opinion choices. The app offers two categories of user login for coach and athlete. The home page contains the coach login and athlete login. Coach login presents the details of coach information, which is viewed only as coach. But the athlete login presents information about the athlete. But this information is viewed by the coach and athlete.

Table 1 illustrates that the javelin distance is calculated between the device (automatic) being offered and the distance being assessed by employing tape. This comparison takes place between the introduced device and the distance (manually). There is barely a variation of up to 0.4 metres between the two approaches. As a result, the method that is advised for the javelin throw is an effective one.

TABLE I. Comparison and Analysis of the Distances Measured between the Gaget, the Tape, and the Javelin

Count of throws	Automatically Distance Measurement (meters)	Manually Distance Measurement (meters)
1	65.75	63.45
2	38.55	43.5
3	65.84	75.9
4	46.42	39.24
5	75.43	88.5
6	58.62	75.4
7	87.33	78.5
8	55.65	45.7
9	49.75	59.6
10	85.15	89.5

The athlete logins view of his measurement is exposed in Table 2. The coach logins the app to view the whole details of all of the athlete and specific athlete by remarking the athlete ID as demonstrated in Table 3. Figure 2 demonstrates the javelin release speed based on the number of counts.

Figure 2 demonstrates the three persons' release speed by the athletes. This figure shows the 10 counts and their corresponding athletes release speed from 20 to 30 metre/sec. Figure 3 explains the Graphical representation of the distance travelled by javelin based on the number of counts. It presents three persons javelin travelled a distance between 40 to 92 metres.

TABLE II. THE ATHLETE'S VIEW

S. No	Date	ID	Athlete Name	Release angle (θ)	Release height (y_0) (meters)	Release velocity (v) (m/s)	Distance travelled (R) (Meters)
1	14-08-18	025	Nirmal	38	2.1	25	60.12
				37	1.9	22	41.88
				43	2	25	72.60
				49	2	21	42.25

TABLE III. COACH VIEW

S. No	Date	ID	Name of Athletes	Angle (θ)	Height (y_0) (meters)	Velocity (v) (m/s)	Travelled Distance (R) (Meters)
1	14-08-18	025	Nirmal	38	2.1	25	60.12
				37	1.9	22	41.88
				43	2	25	72.60
				49	2	21	42.25
2	14-08-18	026	Raksha	47	1.7	28	88.70
				46	1.8	27	67.94
				42	2.1	29	85.75
				39	1.9	27	64.43
3	14-08-18	027	Praveen	45	2.0	24	59.36
				35	1.5	21	44.54
				49	1.7	23	58.78
				48	1.9	27	81.42

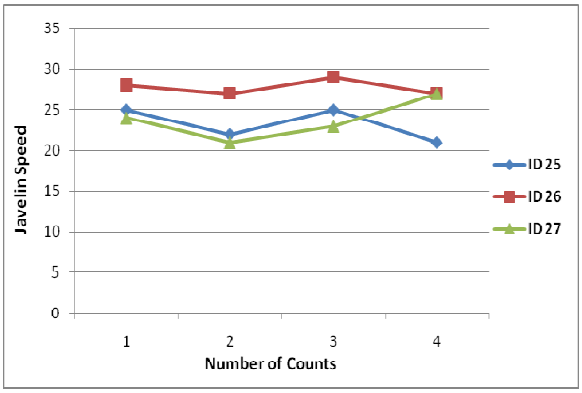

Fig. 2. Release speed of javelin based on number of counts

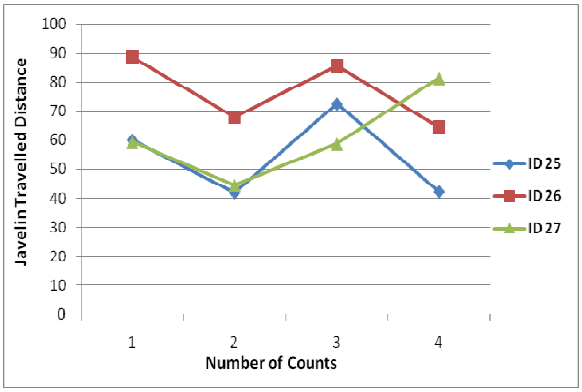

Fig. 3. Graphical representation of distance travelled by javelin based on the number of counts

V. CONCLUSION

This article investigates and checks the javelin athlete's movement parameters using smart WSN. This strategy aims to measure the continuous athlete rank by measuring and observing the athlete's movement parameters like distance, height, speed, and angle of the javelin release. The athletes' classes are kept in a cloud database, and a smartphone app is also being developed. The feedback about the status of the athlete is given through mail. This status brings timely attention as athletes go for their daily practice and assist athletes or coaches in recognizing lagging distance or function. The requirements of designing sporting training in the smart WSN are examined, and the strategy is planned and executed. The investigational outcome illustrates that this strategy satisfies the application necessities of sports training and offers an operational tool for technical training decisions. It is observed that the usage of WSN in the sports training method enhanced the system application. The system uses 20 athlete's data for the performance analysis. In near future the performance of the proposed system can be analyzed using a greater number of athletes and the system can be modified based on the results obtained on larger dataset.

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