Mobile Application as Media Monitoring in the Agility Record System (ARS)

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***Abstract*— This paper discusses a proposed system for measuring athletic agility based on Internet of Things (IoT) technology. The problem with existing agility gauges is that they still use a stopwatch to measure time, and the existing tool only have a few pads and a short distance. The main objective of this paper is to propose the design of an agility measuring system that is simpler and has the ability to coordinate with more motion sensor nodes. This paper also presents the design results of activity diagrams, transaction databases, block diagrams, and hardware configurations of motion sensor nodes. The result of this research is an IoT-based agility measuring system using the ESP8266 module, allowing 253 or more pads to be coordinated. The activity diagram consists of three main actors, namely admin/tester (coach), tester trainer (observer), and athlete actor. In the database design of this IoT-based agility measuring system, it consists of 6 tables, namely three master tables and three transactional tables. The three master tables are the "athletes" table, the "mater_pad" table, the "test_scheme" table. Meanwhile, the three transactional tables are the "test_log" table, the "test_pad" table, the "test_agility" table.**

Keywords: Agility, pad, IoT, ESP, athlete, Measurement

I. Introduction

Wireless measurement technology is a human need in this modern era. This technique provides convenience, high accuracy, and of course, data logging so that data can be stored for analysis needs. Internet of Things (IoT) technology offers convenience in remote data collection [1]–[3], so as if the operator does not have to go to the field, all the necessary data can be collected in one place stored in digital format.

Agility is the ability to change body position or body movement quickly while moving fast without losing balance and awareness of orientation towards body position. Agility is the ability to change the direction of motion in the variable speed, level, and locomotor behavior of an athlete [4]. Sheppard and Young [5] also stated that speed and agility are independent physical abilities. Therefore the development of speed and agility requires a high degree of neuromuscular specificity. However, in reality, agility is not only the speed of movement. Agility is related to the acceleration and deceleration of moving in changing directions but with high consistency, while an athlete tends to slow down with time and age so that his agility will also change. This agility component includes elements of evading, changing body position quickly, moving then stopping, and moving as fast as possible. This ability requires excellent coordination between brain and muscle function [6], While agility is one measure to determine a person's physical ability [5]. Research results from Sabin in 2015 stated that agility should be trained from a young age [7]. Importantly, an athlete must be able to increase and develop speed through agility training.

In the world of sports, agility is the benchmark for an athlete who is stated to have good stamina [8]. Therefore, the measurement of agility through field trials is an important activity in the athlete selection process. Meanwhile, in the health sector, agility is used to measure the muscle and bone function of patients [9]. Generally, patients with joint problems will have difficulty moving in a non-linear direction. In this condition, the agility measurement technology with good accuracy makes a big contribution to the observation of the analyzed data.

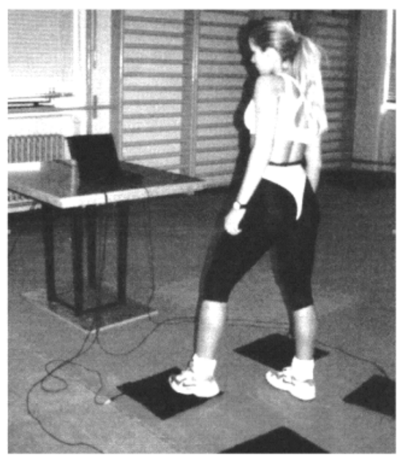

Fig. 1. Test of agility by FiTRONiC [11]

In agility measurement, trainers or observers generally try to get accurate data from any changes in movement or changes in the direction of motion, and then these data can automatically provide conclusions about a person's agility. The problem with current agility measurements is a device that can detect motion and transmit input data remotely at a multi-point is needed (Fig. 1). Meanwhile, the commonly used measuring instrument is a stopwatch, which is prone to human error due to errors in observation [10], [9]. Therefore, we need agility measurement technology that is easy to use, simple, independent, and has the ability to transmit measured data remotely.

This paper is based on existing agility measurement technologies, for example, FiTRONiC [11], which then proposes a design and work procedures for machines and a support system of an agility measurement system based on the Internet of Things (IoT). The problem with the existing agility measuring technology is the limited number of sensor nodes and the limited distance due to the use of cables. The number of sensor nodes can be increased by using an IP address-based network [12], and the distance can be extended using a wireless network. This paper also describes the engine configuration from motion sensors to database configuration on the server.

II. Related Worked

Several motions flow models for agility testing for children aged 10-12 years have been introduced by ISSopa and M. Pomohaci in 2014. Reference [7], such as the sidestep model as a measurement model for agility in rugby [4], [7], [8], [10], on the sport of tennis [13] or gameplay [6]. These models certainly require modern agility measuring instruments. While manual agility gauges have been proposed in [14], where these measurements only occur in humans moving on a treadmill and then produce data on differences in velocity changes in the athlete's knee joint.

Agility time was measured using the computer-based FiTRO Agility check system (FiTRONiC sro) with an error of 7.1% [11]. FiTRONiC sro is used using cables and displays that can be monitored directly by the athlete. But FiTRONiC sro cannot be used for multiple athletes simultaneously, and the space is limited.

FiTRONiC provides agility data from the athlete via the supplied pad. The pad is connected to the monitoring device via a cable. Measuring agility obtains speed or acceleration data for each change in the direction or motion of the athlete. From these values, it can be concluded the level of stability of human or athlete movement. Communication between the pad and the server on FiTRONiC uses a cable. Of course, this is a limitation of the device. While inside [15] offers communication techniques between machines using the Batch Processing Method in Machine to Machine Wireless Communication as Smart and Intelligent System.

The measurement technique using a wireless sensor network (WSN) communication technology has been successfully carried out, which is used to reduce failure in measurement in the structural health monitoring (SHM) program [9]—introducing a prototype based on multi-agent technology called the Never Miss An Opportunity Scheme (NMAOS) model.

In NMAOS, the pad consists of a triggering agent, comparative agent, and sensor agent, and the working principle of NMAOS is to detect the pressure on the athlete's muscle and then with WSN technology, the athlete's muscle pressure information becomes an input to the automatic collaboration agent, this information is then passed on to the damage diagnosis. Agent and then terminating in a prognostic agent (Fig. 2).

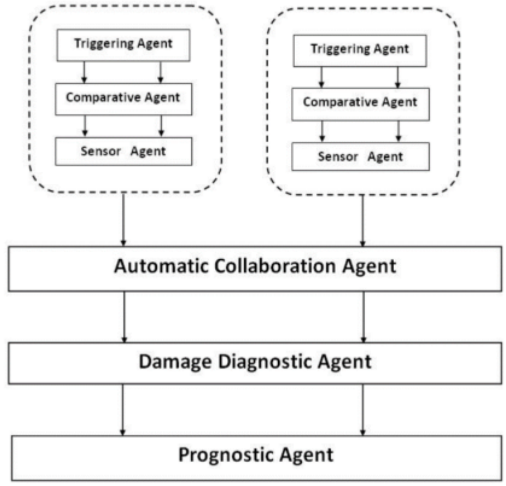

Fig. 2. Multi-agent Architecture for an Agile WSN [9].

From FiTRONiC technology [11] and NMAOS technology [9] has a difference, namely the motion sensor communication to the server, FiTRONiC uses wired communication, while NMAOS uses wireless technology with WSN technology. In terms of agility measurement technology, NMAOS is not designed to facilitate the evaluation of the athlete's agility but tends to be used to measure changes in human muscle function. In addition, NMAOS cannot be used on multiple athletes simultaneously. We see that agility measurement technology, especially in athletes with a large number of athletes, requires easy-to-use technology, where the coordinating unit (server) can arrange and identify the sequence and position of the pads, so that this technology can be used in the direction of motion patterns according to the assessor's wishes. or supervisor.

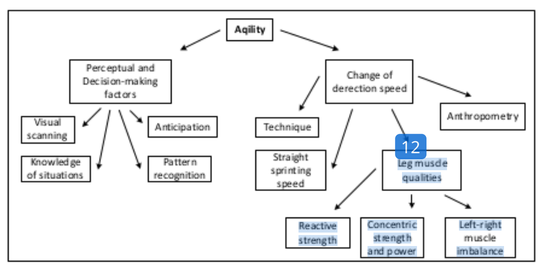

Fig. 3. General components of agility motion [6].

Based on Fig. 3, in general, the definition of the agility component is divided into two components. First, the perception component and the factors determine the decision, and the second is the change in direction and speed [6]. The perception component is influenced by several dominant components, namely vision, anticipation, recognizing patterns, knowledge of situations. While the components of changes in direction and speed are influenced by movement techniques, strength, anthropometry, and leg muscle quality. Meanwhile, leg muscle strength is influenced by the reaction force, focus strength, and balance between right and left muscles.

III. Result and discussion

As stated earlier, this paper produces a work procedure design of an IoT-based agility measurement system. This is important because good design guarantees good product results. Therefore it is very important that the design is made starting from the work procedures of the machines and support systems involved.

The agility system design that we design consists of two main systems, namely the agility sensor system (pad) and the server system. The agility sensor (pad) system consists of several components, namely a microcontroller using Wemos type D1-mini with MCU ESP8266, communication protocol using HTTP at 2.4 GHz communication frequency and IEEE 802.11 b/g/n WiFi protocol.

The choice of the ESP8266 MCU is because this module has a small size, only 4.83 cm, 2.54 cm wide and only weighs 2 grams. Besides being small in size, the ESP8266 supports STA + AP mode, which functions as both a station and an access point. This feature allows the ESP8266 to be programmed to form a mesh network. On the basis of these reasons, we conclude that the ESP8266 will be suitable for use as a node on the athlete's agility measurement system pad. However, the ESP8266 is also used in energy monitoring systems [16]–[18].

The system work procedure starts from a mechanical switch providing input to the MCU through an analog to digital converter (ADC) process. The data that has been received by the MCU is then processed and sent to the server via wireless communication. On the server-side, there is only one main part of the data received through the access point antenna. This configuration will allow pad communication with the server to occur wirelessly with a WiFi network, and then the monitoring data can be displayed on a mobile monitoring device, such as a cellphone, tablet or laptop as long as the device has WIFI facilities. The status and arrangement of the pad can also be adjusted via the mobile device.

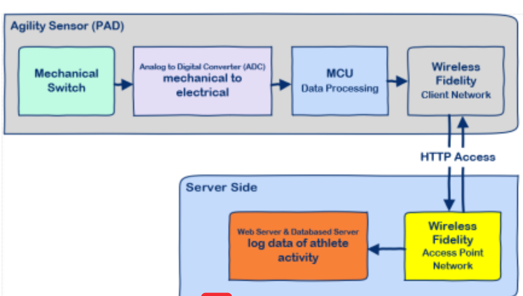

Fig. 4. Block diagram and the working principle of the sending module design system

The working principle of the system (Fig. 4) begins with a mechanical quantity converted into an electrical mechanical switch. Then the analog quantity is converted into a digital scale using the analog-digital Converter (ADC). The digital data is processed and then converted into electromagnetic waves. The magnitude of the electromagnetic waves is sent to the server using a high-level protocol network, namely WiFi based on the IEEE 802.11 standard. The server will convert the wave size into numeric and graphical data.

Fig. 5 is a pad design in which the mechanical switching and MCU become one part on each pad. Meanwhile, Fig. 6 shows the Design of an IoT-based agility measurement system activity diagram..

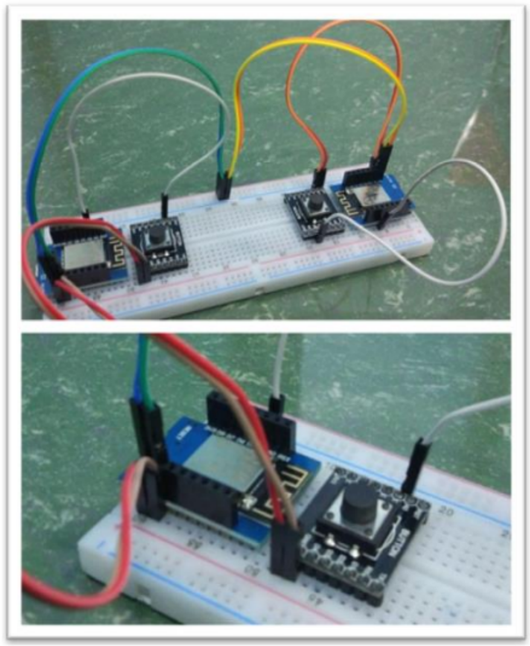

Fig. 5. The physical configuration of mechanical switching on the MCU ESP8266.

We make the design of the activity diagram as simple as possible so that the system does not need to carry out complex procedures. We determined that only 3 important actors were involved, namely admin/tester (coach), tester trainer (observer), athlete. In practical terms, admins and testers can be the same person or different people. The main difference between the admin actor and the tester actor is that the admin is the actor who is responsible for determining the model or exam scheme to be implemented, while the tester actor is the person who determines the order of the athletes that will conduct the exam. Altet actor is an object to be tested or perform agility testing.

The flow of the activity diagram design starts from the admin determining the test scheme to be applied, then synchronizing between the server and the pad using WIFI communication. Synchronization is a procedure for determining the status of which pad acts as the start pad, the next pad to determine the end pad. If this procedure was successful, it means that the server-to-pad synchronization was successful. Because the ESP8266 module supports STA + AP mode, which functions as a station and access point, if it is assumed that the pad address is based on class C Ip-Address based servers, in theory, the server can coordinate with 253 pads. This is what is different from the FiTRONiC agility system [11], where the pad used is limited and according to the number of analog input available from the receiver module.

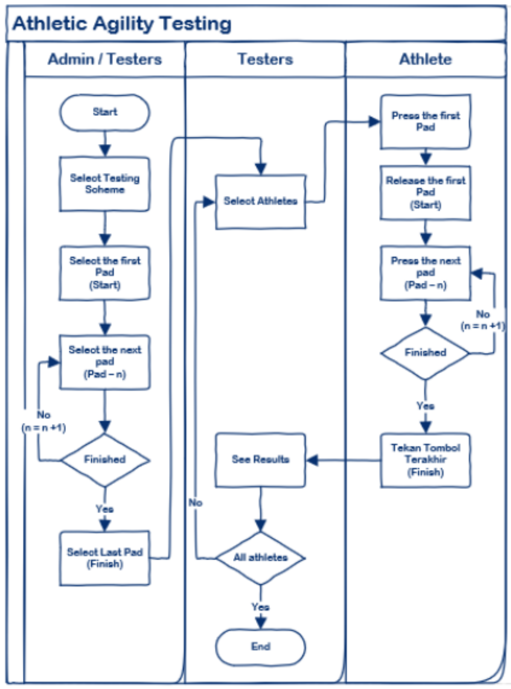

Fig. 6. Design of an IoT-based agility measurement system activity diagram.

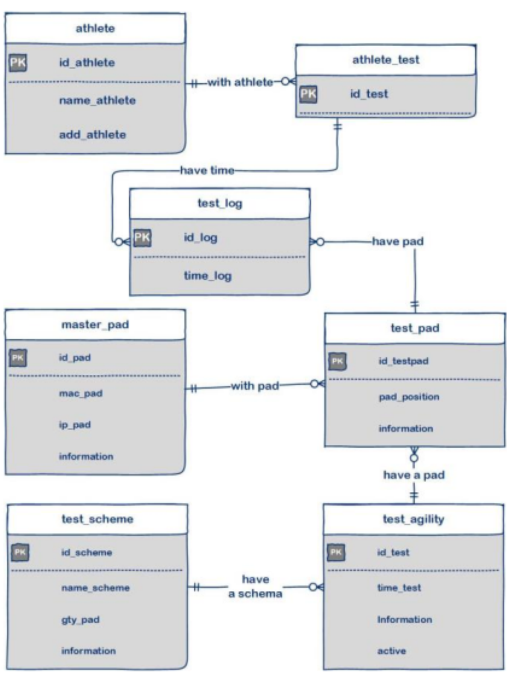

Fig. 7. The design of the IoT-based agility measurement system database

After the synchronization is successful, then the actor tester sets the order of the athletes and then determines the first athlete to be tested. The athlete actor started to step on the first pad. When the first pad is released from the stampede, the speed input value and the time delay from the first pad to the next pad are calculated until the last pad. The total score of each athlete will be recorded and stored on the server and then displayed on the scoring interface of the actor tester.

In the database design of this IoT-based agility measuring system (Fig. 7), it consists of 7 tables, namely three master tables and four transactional tables. The three master tables are the "athletes" table, the "mater_pad" table, the "test_scheme" table. Meanwhile the three transactional tables are the "athlete_test" table, the "test_log" table, the "test_pad" table, the "test_agility" table. The working procedure of designing this database is where the admin actor accesses the athlete list from the "athlete table", then selecting athletes is done in the transaction table, namely the "athlete_test" table. Athletes who are selected and perform the test will fill in the test result data in the table "test_log". Pad status results from the coordination of the internal server with each pad will be stored in the table "test_pad".

IV. Conclusion

Several statements can be drawn as a conclusion from this paper, namely the design of an agility measurement system based on IoT technology consisting of two main modules, first the pad module as an athlete motion trigger and communicating with the server using WiFi communication, the second server module as a pad coordinator module, data processing, monitoring the results of the evaluation of the athlete's agility.

The communication pad to the server module uses the ESP8266 module which features STA + AP mode with class C IP-address addressing, allowing the server to coordinate with as many as 253 pads.

The activity diagram consists of three main actors, namely admin/tester (coach), tester trainer (observer), athlete. In practical terms, admins and testers can be the same person or different people. The main difference between the admin actor and the tester actor is that the admin is the actor who is responsible for determining the model or exam scheme to be carried out, while the tester actor is the person who determines the order of the athletes that will conduct the exam. Altet actor is an object to be tested or perform agility testing. In the database design of the IoT-based agility measuring system, it consists of 7 tables, namely three master tables and four transactional tables. The three master tables are the "athletes" table, the "mater_pad" table, the "test_scheme" table. Meanwhile the four transactional tables are the table "athlete_test", "test_log",

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