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Design of a Microcontroller-based Data Acquisition System for Measuring Sprint Speed in Athletes

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***Abstract*—It has been developed a microcontroller-based athlete sprint speed data acquisition system. The infrared sensor has two components that act as start and stop, after which the signal is forwarded to the Nodemcu microcontroller and interpreted as a millisecond time variable. The signal is sent to the user via the cloud hosting server, which can be viewed via a smartphone after the data has been processed. The athlete sprints through the two sensors 10 times as a replacement for the 100-meter sprint after putting sensor A and sensor B 10 meters apart. Several factors can cause quick or slow travel time when recording athletes' sprints, including (1) The angle created by the body during a run, where the angle of movement influences the width of the steps in the range from a biomechanical standpoint. As a result, the wider the steps are, the greater the distance covered in a single sprint stage. (2) data on athlete endurance and stamina when performing spontaneous 100 m sprints; however, based on the graph created, all athletes do not experience a substantial decrease in speed, implying that the athlete's muscle endurance when performing 100 m sprints is still in good shape. (3) the speed at which data is transmitted from sensors to cloud storage; this may occur if there is a network or service interruption.**

Keywords—atlet, sprint, microcontroller, sensor

I. INTRODUCTION

The pace is a vital element in martial arts. to improve an athlete's pace in a race various training methods are required in terms of action and reaction, one of which is speed training. In terms of speed, In a broad sense, martial arts can be described as self-contained physical abilities with their own set of requirements for growth [1]. In simple terms, velocity is a specific independent physical motor that evolves in tandem with bioreceptor development. In general, velocity is defined as the difference between the speed of action and the speed of reaction. The speed of action refers to the time it takes to initiate an attack on an opponent, while the speed of reaction refers to the time it takes to respond to an attack or stimulus from an opponent. Various styles of speed training are necessary to improve speed in martial arts. Sprint training is one form of speed training. Sprinting is a form of sprint training used by fighters to improve their stamina, concentration, speed, and agility. The reaction time in seconds is the velocity's output parameter (seconds).

This type of exercise has so far only been mediated by the use of a stopwatch. The use of a stopwatch has flaws, such as pacing precision, which affects the speed at which targets or training objectives are met. As a result, we need technology that can reliably and in real-time calculate a fighter's running pace. The Internet of Things is one of the technologies that is currently being created (IoT). The Internet of Things (IoT) is a phenomenon in which some objects can transmit data over a network without needing human-to-human or human-to-computer interaction. IoT-based technology can be used in a variety of fields, including badminton, where microelectromechanical motion sensors (MEMS) are used to classify players' ability levels [2]. Besides, the Internet of Things is being used in football games, where Artificial Intelligence is used to predict the patterns of opposition teams [2]. According to research Elumalai and Ramakrishnan [3] and Ikram et al. [4], IoT technology can read heart rates in running athletes and predict the risk of injury [5].

Based on some of the existing research, there is still a need for further research into some of the IoT's untapped potential, such as its use in Pencak silat training. As a result, the authors are interested in researching and improving Internet of Things-based research that can be used in Pencak silat training. The use of IoT-based technology for sprint speed training for Pencak silat athletes is a novel aspect of this study. Later on, the results of this study will be compared in terms of time, distance, the velocity of each point, and average velocity. These variables will be the initial data in deciding the training menu or intensity of the next athlete's training after they are read by the sensor.

II. Methods of Research

A. *Machine Design*

The hardware design of a microcontroller-based speed measurement device starts with the design of several components, including

- Infrared Obstacle Sensor 2 Unit
- MCU nodes,
- Jumper Cables, and a
- DC 9 V adapter as a voltage source are all included.

The circuit's schematic is shown in Figure 1.

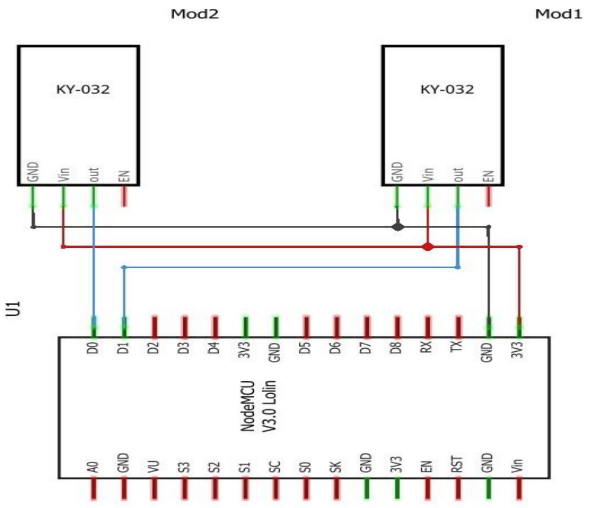

Fig. 1. Displays a circuit diagram.

The infrared sensor has two components that act as start and stop, as shown in Figure 1, and the signal is forwarded to the nodemcu microcontroller to be interpreted as a time variable in milliseconds. Following the processing of the data, a signal is sent to the user via a cloud hosting server, which can be viewed via a smartphone using an application framework workflow as shown in Figure 2 below:

Transduser → Nodemcu→Cloud Hosting → User

Fig. 2. Shows the system's workflow.

Each digital signal from the sensor is forwarded to the nodemcu microcontroller, which is then sent to cloud hosting via a wireless or wireless link, as shown in Figure 2. From the standpoint of cloud hosting, it only acts as temporary storage before being processed and forwarded to the user via an output device, such as a web view on a desktop or an Android app that can be tracked in real-time.

B. *Evaluation*

Sensor A and B are placed 10 meters apart for the measuring procedure, and the runner sprints through the two sensors 10 times instead of running the 100-meter sprint. The machine will then measure the athlete's sprint speed and average speed at each point it passes.

III. Results and Discussion

Based on data collected in the field from five athletes who alternate sprint tests. Table 1 indicates the information collected. The athlete must cover a distance of 20 meters for each recording data.

TABLE I. SPRINT RECORDING OF 100M ATHLETES

No	**Data**	**Node Sensor (ms)**					**ΣTime**	**Average Velocity (m/s)**
		1	***2***	***3***	***4***	***5***		
1	A	262	259	267	270	268	1326	7,54
2	B	260	262	261	265	272	1320	7,58
3	C	265	268	271	277	275	1356	7,37
4	D	270	278	278	280	320	1426	7,01
5	E	250	280	290	330	315	1465	6,83

The travel time for a distance of 100 m that is partitioned into 5 reps with a distance of 20 m for each rep can be seen in the table. Equation 1 can be used to measure each athlete's average speed based on the time obtained:

$$V = \frac{s}{t} \quad ..(eq.1)$$

for information:

v = velocity (meters per second)

s = travel distance (m)

t = time (second)

The value of the counter time calculation in milliseconds (ms) is also shown in Table 1, so it is important to convert from that unit to seconds (second). A graph of the athlete's average speed is shown in Figure 2 below:

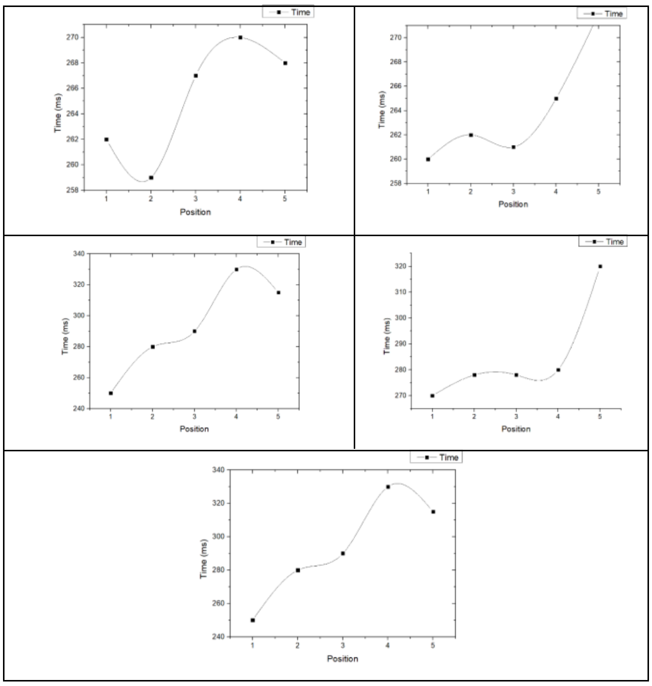

Fig. 3. Every 20 meters, the athlete's travel time is graphed.

The graph shows that data 1, 3, and 4 experienced a rise in pace in the last 20 meters, as shown by a decrease in travel time, while data 2 and 4 graphs appear to increase, owing to increased travel time and decreased speed of athletes when sprinting at a distance of 20 to 40 meters. Although the graph in data 5 appears to be constant, it is reasonable to conclude that there is no substantial change in speed. Several factors can cause quick or slow travel time when recording athletes' sprints, including (1) The angle created by the body during a run, where the angle of movement influences the width of the steps in the range from a biomechanical standpoint. According to Faizah [6], the wider the steps are created, the greater the distance produced in one step in the sprint movement [7]. (2) data on athlete endurance and stamina when performing spontaneous 100 m sprints; however, based on the graph created, all athletes do not experience a substantial decrease in speed, implying that the athlete's muscle endurance when performing 100 m sprints is still in good shape. (3) the speed with which data is sent from sensors to cloud hosting; this can occur if there is interference or a network; since the installed instrument is based on an internet network that is linked wirelessly through a cellular network, the speed with which data is sent and received is a significant factor inaccuracy. the instrument.

IV. CONCLUSION

Based on the data analysis, a microcontroller-based real-time sprint speed data acquisition system was designed. The Nodemcu ESP8266 microcontroller is used, along with two light sensors that serve as a timer. The data collected by the sensor is processed on the microcontroller before being stored on cloud hosting as a distortion medium that users can access using Android or desktop devices. The athlete's anatomy during the sprint, tissue integrity and agility or stamina all contribute to the response time for sprint recording.

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