ROLLER DRIVE TRAINER WITH ADJUSTABLE THREE-LEVELS BY MICROCONTROLLER

Somkiat Malipan
Department of Electrical Engineering, Faculty of Industry and Technology,
Rajamangala University of Technology Isan, Sakon Nakhon Campus, Pangkhon district,
Sakon Nakhon 47160, Thailand

ABSTRACT

Roller drive trainer with adjustable three-levels by microcontroller, control of three-levels way which are normal level, desert level, roughness level, show distance, time and calorie display LCD monitor, create three-levels rollerblading trainers. Microcontroller is applied for modern technology to exercise. The Arduino UNO R3 microcontroller is used as a controller and complete. The spin compares distance and the spin distance on the machine. Flat 6.38 % error, spin speed variation was 6.64 %, spin distance was erroneous 6.16 %. Trainer drive roller with adjustable three-levels by microcontroller is flat, sandy, rugged way and it can also calculate calorie intake from the spin distance in using roller drive trainer with adjustable three-levels by microcontroller.

KEYWORDS: Roller drive trainer, microcontroller

1. Introduction

Nowadays, humans begin to focus more on health to make a healthy body. The most way of having a healthy body will be exercise and can be done in several ways but now the popular exercise is the bicycle spin there are a spin activity for the father, spin activity “bike for Mom” therefore, spin is known and popular. The spin gives many advantages for the healthy body and enjoyment of the surrounding exploring the atmosphere and nature. Spin is a sport for competition or event for exercise but sometimes to spin outside may have obstacles, such as roads are not safe, slow work, traffic jams, raining, hot weather, there is not enough light to spin at night, addicted to some TV Program that need regular watching, or other causes.

The concept of this paper is to create a 3-level roller with a microcontroller using the motor to adjust the spin difficulty can show status of spin all of distance and time to the virtual bike, also can choose the spin in three-levels. 1. Smooth roads. 2. Spin in the sand road. 3. Spin in the rough road. Three-levels must be as virtual bike in the road, can spin every time and don't have any risk accidents for accident on the road and no weather fluctuation.

2. The purpose of the research

- To design and create the Roller drive trainer with adjustable three-levels by microcontroller
- To use new technology to apply in the exercise

3. The scope of the research

- Roller drive trainer with adjustable in normal level
- Roller drive trainer with adjustable in desert level
- Roller drive trainer with adjustable in roughness level
- Roller drive trainer with display of spin distance
- Roller drive trainer with display of spin timer
- Roller drive trainer with display of calories
- Roller drive trainer with weight not over 150 kgs.
- Roller drive trainer with reset all of time, distance and calories

4. Materials and Method of the research

4.1 Research method

Roller drive trainer with adjustable three-levels by microcontroller block diagram shown in figure 1.

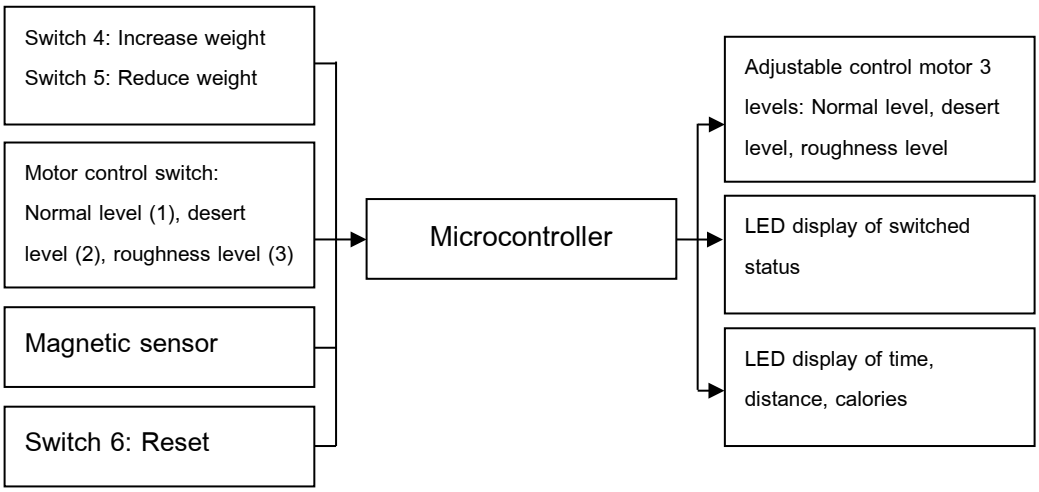

Figure 1 Block diagram of a roller adjuster 3 levels with microcontroller.

It works by getting the value from the switch and being sent to the microcontroller to process and calculate the results for sending to the LCD Display when the switch 4 and 5 are input with the weight of each person. Switch 1 is motor control of roller drive trainer with adjustable in normal level, switch 2 is motor control of roller drive trainer with adjustable in desert level, switch 3 is motor control of roller drive trainer with adjustable in roughness level. The magnetic sensors found magnetic signals will send the data to microcontroller for LCD Display of all of the distance, time, and calorie consumption.

4.1.1 Arduino R3 microcontroller connection

Three-levels rollers with microcontrollers work by selecting the switch the then the switch transmits the signal to the microcontroller and the microcontroller computes the results and transmits to LCD display for displaying, while motor will adjust the difficult level in cycling when the switch is on, the infrared sensor works and then press the switch 4 or 5 to increase or reduce the weight, height and age, after that press switch 1 to spin after that microcontroller process the data and send to LCD display to indicate the distance, time and calories.

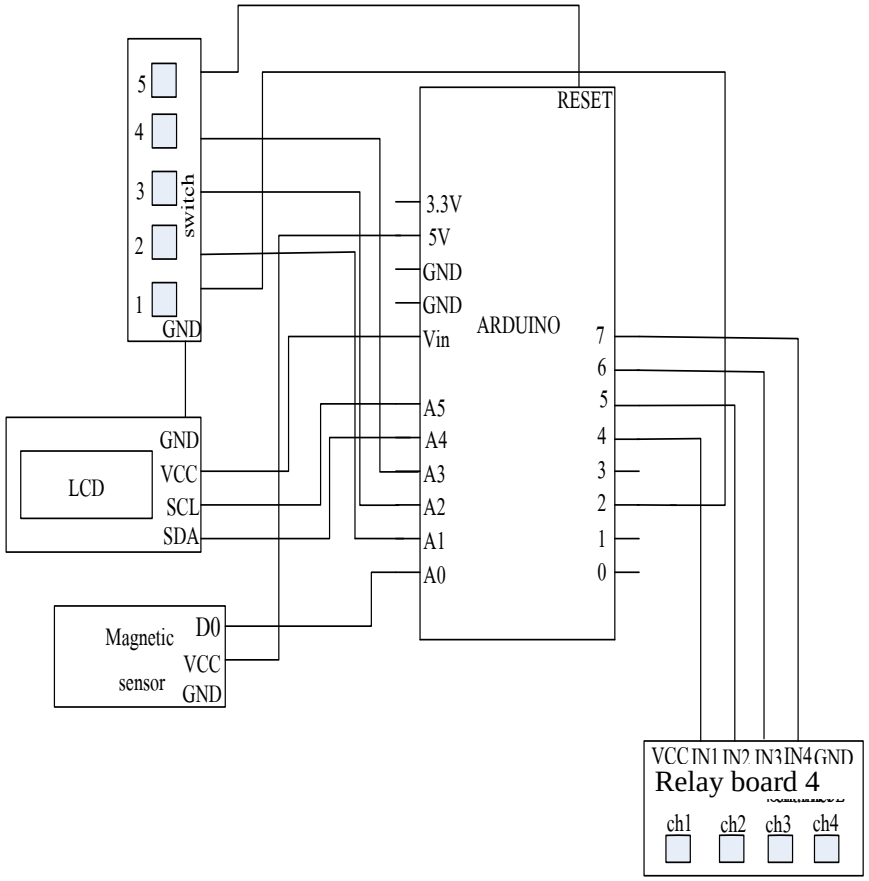

Figure 2 Arduino R3 microcontroller connection

4.1.2 Roller drive trainer with adjustable three-levels by microcontroller design

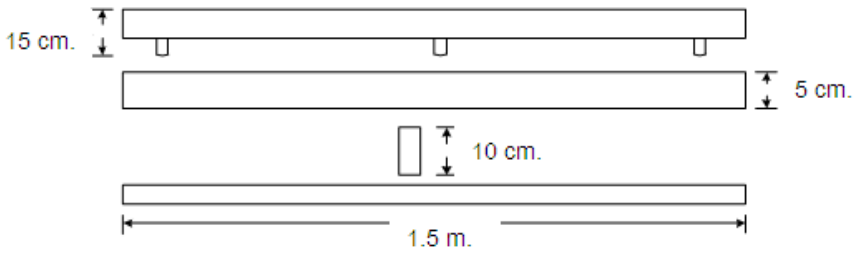

Figure 3 Base structure

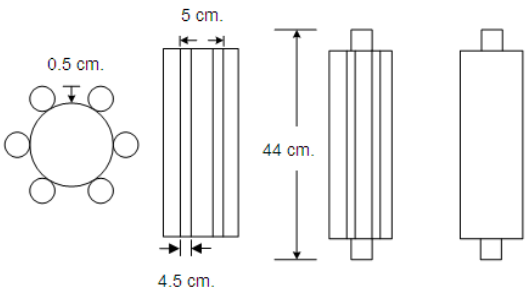

Figure 4 Roller structure

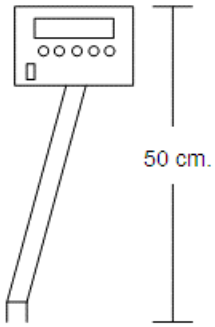

Figure 5 LCD structure

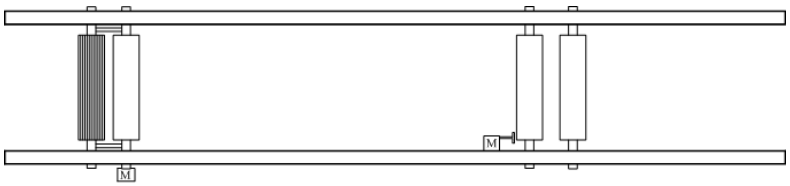

Figure 6 Base and Roller Assembly structure

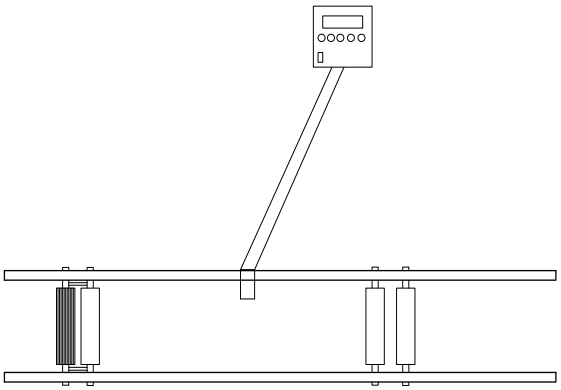

Figure 7 Roller drive trainer with adjustable three-levels by microcontroller structure

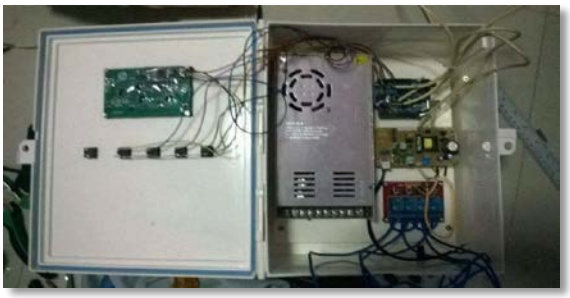

Figure 8 **Roller drive trainer with adjustable three-levels by microcontroller with material in the box**

Figure 9 **Roller drive trainer with adjustable three-levels by microcontroller structure**

4.2 The experiment

4.2.1 Magnetic Sensor Output Test

The paper begins with a survey of the magnetic sensors currently used the area of non-destructive evaluation [1]. There are many types of magnetic sensors based on different technologies. Traditional inductive eddy current probes based on excitation/detection coils as well as magnetic field transducers are analyzed. Magnetic sensor assembly at D0 pin with A0 of microcontroller and input DC voltage (5 VCC) to magnetic sensor and measure the output signal of magnetic sensor.

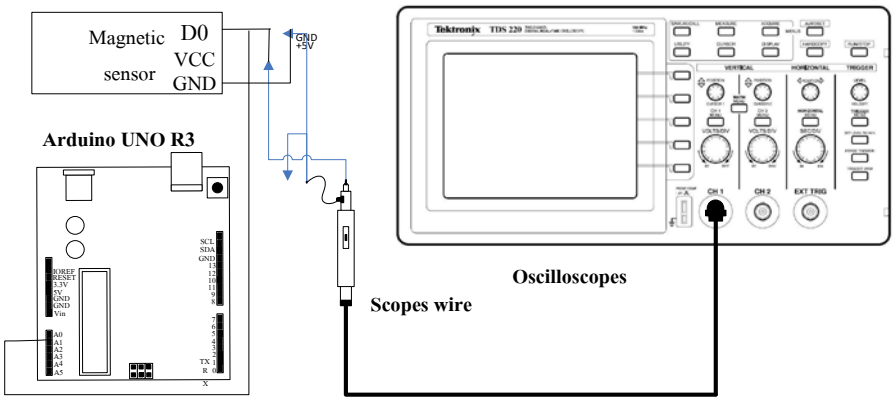

Figure 10 Magnetic sensor output signal test

The magnetic sensor signal on the GND and D0 pin if D0 is low logic (Logic “0”) this status isn’t operated, when D0 is high logic (Logic “1”) this status is operated. The experiment is 10 times, each time of measurement is the same signal as figure 11.

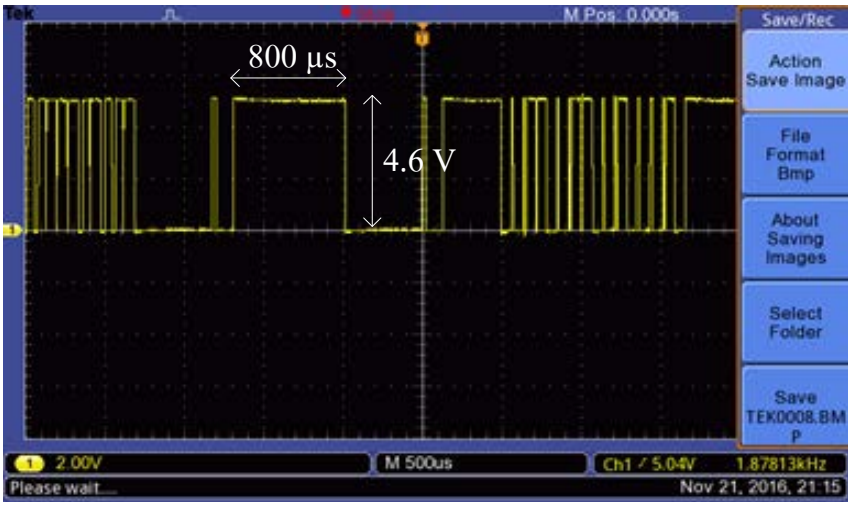

Figure 11 Magnetic sensor signal image

4.2.2 Spin test

Spin test:

- Roller drive trainer with adjustable in normal level
- Roller drive trainer with adjustable in desert level
- Roller drive trainer with adjustable in roughness level

- Roller drive trainer with display of spin distance
- Roller drive trainer with display of spin timer
- Roller drive trainer with display of calories
- Roller drive trainer with weight not over 150 kgs.
- Roller drive trainer with reset all of time, distance and calories

Figure 12 Spin test

5. Result of the research

5.1 The experiment on the weight of Roller drive trainer with adjustable three-levels by microcontroller

Roller drive trainer with adjustable three-levels by microcontroller, control of three-levels way are normal level, desert level, roughness level. There are tested 10 times each level with the weight is not over 150 kgs. The roller drive trainer with adjustable three-levels by microcontroller can be used with the maximum of weight within 150 kgs per time.

5.1.1 Work experiment of roller drive trainer with adjustable three-levels by microcontroller with 150 kgs of user

Table 1 Work experiment of roller drive trainer with adjustable three-levels by microcontroller with 10 Km. in normal level, desert level, roughness level

Times	Roller three-levels					
	normal level		desert level		roughness level	
	Weight (Kg)	Trainer status	Weight (Kg)	Trainer status	Weight (Kg)	Trainer status
1	150	/	150	/	150	/
2	150	/	150	/	150	/
3	150	/	150	/	150	/
4	150	/	150	/	150	/
5	150	/	150	/	150	/
6	150	/	150	/	150	/
7	150	/	150	/	150	/
8	150	/	150	/	150	/
9	150	/	150	/	150	/
10	150	/	150	/	150	/

Remark: / = Normal, x = Damage

5.2 Spin distance experiment in normal level

Table 2 Comparison of Roller drive trainer with adjustable three-levels by microcontroller in normal level

Times	Time (Minute)	Distance (Km.)		Distance difference (Km.)	Error (%)
		Real distance	Trainer distance		
1	30	9.1	8.4	0.7	8.1
2	30	6.2	5.8	0.4	5.2
3	30	8.4	7.9	0.5	7.4

Table 2 (continued) Comparison of Roller drive trainer with adjustable three-levels by microcontroller in normal level

Times	Time (Minute)	Distance (Km.)		Distance difference (Km.)	Error (%)
4	30	6.5	6.1	0.4	5.5
5	30	7.4	6.9	0.5	6.4
6	30	8.5	8.7	0.2	7.4
7	30	6.4	5.9	0.5	5.4
8	30	7.4	6.9	0.5	6.4
9	30	7.8	6.9	0.9	6.9
10	30	6.1	6.4	0.3	5.0
Mean error					**6.38**

The results of the experiment

The comparison of the real distances and trainer distance on the machine with the spin time of 30 minutes, each time in the spin will be in different distance for comparison to find the error between the real distance and trainer distance which is 6.38%.

5.3 Spin distance experiment in desert level

Table 3 Comparison of Roller drive trainer with adjustable three-levels by microcontroller in desert level

Times	Time (Minute)	Distance (Km.)		Distance difference (Km.)	Error (%)
		Real distance	Trainer distance		
1	30	4.1	4.7	0.6	5.1
2	30	5.4	5.9	0.5	6.3
3	30	4.9	4.1	0.8	7.0
4	30	6.1	6.4	0.3	7.0
5	30	5.3	4.9	0.4	8.3
6	30	6.6	6.1	0.5	7.6

Table 3 (continued) Comparison of Roller drive trainer with adjustable three-levels by microcontroller in desert level

Times	Time (Minute)	Distance (Km.)		Distance difference (Km.)	Error (%)
7	30	5.4	5.8	0.4	7.3
8	30	6.1	5.4	0.7	5.2
9	30	6.3	6.8	0.5	5.2
10	30	6.4	5.6	0.8	7.4
Mean error					**6.64**

Spin experiment in desert level use the rubber to viscosity as a roller against the viscosity.

The viscosity is derived from the equation.

$$\text{Brake resistance} = T / r \quad (1)$$
$$= 0.75m / 2.5 = 0.3\ N$$

where T = braking traction, r = radius of sphere object

Table 4 Wheel rotation coefficient (Kr) based on road type and condition [2]

Type of road condition	Kr (Average) (1)
Sand road	0.10-0.30 N (1)

The average coefficients from the rotation of the brake wheel to make the wheel traction. It is close to the coefficient of wheel rotation by type and road condition.

The results of the experiment

The comparison of the real distances and trainer distance on the machine with the spin time of 30 minutes, each time in the spin will be different distance for comparison to find the error between the real distance and trainer distance which is 6.64%.

5.4 Spin distance experiment in roughness level

Table 5 Comparison of Roller drive trainer with adjustable three-levels by microcontroller in roughness level

Times	Time (Minute)	Distance (Km.)		Distance difference (Km.)	Error (%)
		Real distance	Trainer distance		
1	30	6.7	7.1	0.4	5.6
2	30	5.9	6.4	0.5	4.8
3	30	7.4	7.9	0.5	6.3
4	30	8.5	7.9	0.6	7.5
5	30	7.4	6.9	0.5	6.4
6	30	8.5	8.7	0.3	7.3
7	30	6.4	5.9	0.5	5.4
8	30	7.4	6.9	0.5	6.4
9	30	7.8	6.9	0.9	6.9
10	30	6.1	6.4	0.3	5.0
Mean error					**6.16**

Calculate the roughness coefficient

$$Sr = \frac{a}{\Omega - \beta} \qquad (2)$$

$$= \frac{1}{5 + 0} = 0.2 \text{ m}$$

where Ω is the frequency

β is the shaped coefficient of roughness expansion rate

a is the roughness level determined in the roughness coefficient.

Sr is the roughness coefficient

Calculate the roughness coefficient correspondence to the roughness of the surface [3]. The international roughness index (IRI), which is the road surface level by the wheel of the car touch on the road surface in m/km or mm/m

The results of the experiment

The comparison of the real distances and trainer distance on the machine with the spin time of 30 minutes, each time in the spin will be different distance for comparison to find the error between the real distance and trainer distance which is 6.16%.

5.5 The calories quantity experiment in cycling

Experiment on the quantity of calories in cycling of Roller drive trainer with adjustable three-levels by microcontroller in table shows the calories burnt in the spin which divided into age ranges and sexes range from 13 to 60 years, divided into 30 trials. The calorie equation was used as follows.

Formula for energy metabolism of the body

BMR (Basal Metabolic Rate) [4]

$$\text{Males} = 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (y)} + 5 \quad (3)$$

$$\text{Females} = 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (y)} - 161$$

5.6 The calories quantity experiment in cycling 10 Km./ 1 hour of roller three-levels

Table 6 Comparison of Roller drive trainer with adjustable three-levels by microcontroller in calorie

Times	Weight (Kg)	Roller three-levels		
		normal level Kilo Calorie	roughness level Kilo Calorie	desert level Kilo Calorie
1	70	315	390	678
2	70	320	388	680
3	70	302	402	690
4	70	309	411	685
5	70	296	395	694
6	70	327	420	682

Table 6 (continued) Comparison of Roller drive trainer with adjustable three-levels by microcontroller in calorie

Times	Weight (Kg)	Roller three-levels		
		normal level Kilo Calorie	roughness level Kilo Calorie	desert level Kilo Calorie
7	70	321	408	688
8	70	315	415	694
9	70	318	398	676
10	70	305	412	685
Mean		**312**	**403**	**685**

The results of the experiment

The calories experiment in cycling 1 hour of roller three-levels. The result is normal level has lower calories, roughness level has middle calories and desert level has higher calories are $\overline{X}$ = 312, 403, 685, respectively.

6. Expected Benefits

- Reduce the accidents on the road
- Increase skill to spin
- Increase muscle strength
- Build up healthy body
- Burn calories
- Flexible to spin any time

7. Conclusions

Roller drive trainer with adjustable three-levels by microcontroller can use in the physics of exercise for spinning bike with ability to adjust in normal level, roughness level, desert level with the different value respectively in significant and able to show the spin distance, spin timer and calories, this trainer can use with the person of not over 150 kg of weight. Comparison of Roller drive trainer with adjustable three-levels by microcontroller in normal

level with error 6.38%, comparison of Roller drive trainer with adjustable three-levels by microcontroller in desert level with error 6.64%, comparison of Roller drive trainer with adjustable three-levels by microcontroller in roughness level with error 6.16% while the calories experiment in cycling 1 hour of roller three-levels there are normal level, roughness level, desert level with $\overline{X}$ = 312, 403, 685 respectively

Reference

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Author's Profile

Somkiat Malipan, lecturer at Rajamangala University of Technology Isan Sakonnakhon Campus. Address: 199 Moo.3 Pangkhon-Warichaphom Road, Pangkhon subdistrict, Pangkhon district, Sakon Nakhon 47160. Tel. 0-4277-2285, Fax. 0-4277-2158, Mobile phone: 086-4140587, E-mail: life_alert2@hotmail.com. He received Master's degree in Electronics from King Mongkut's Institute of Technology Ladkrabang and Bachelor's degree in Electronics Engineering from King Mongkut's Institute of Technology Ladkrabang.

Interested research area: Industrial electronics, Power electronics, Optical communication, Telephone Engineering, Computer for education, Electronics circuit design.