Design Of Building Gear Motion Control Systems on Bicycles Using Voice Comments

Ilham Ramadhan Putra[1], Putri Elfa Mas'udia[2], Hadiwiyatno[3]

[1]Digital Telecommunication Networks Study Program,
Department of Electrical Engineering, State Polytechnic of Malang, Malang, Indonesia
[2,3]Telecommunication Engineering Study Program
Department of Electrical Engineering, State Polytechnic of Malang, Malang, Indonesia

[1]pilhamramadhan@gmail.com, [2]putri.elfa@polinema.ac.id, [3]hadiwiyatno@polinema.ac.id

***Abstract*—The driving system on the bicycle is connected through a lever called a shifter placed on the lever grip and controlled by the driver simply by pushing the shifter lever with a finger. The shifter is then connected to a wire cable that becomes an intermediary that attracts the derailleur rear with the aim of moving the chain, therefore, an automatic gear system design is made using sound identification to reduce the negligence and fatigue in moving the lever with voice recognition. This study uses recognition that able to process the sound identification spoken by someone without regard to the identity of related people. Voice recognition will be connected to a device receiver that is connected wirelessly to the device transmitter as the receiver of the command in the form of a sound. Voice recognition is also connected to the microcontroller connected to the servo motor to move the derailleur rear as a gear drive. The results of research on the gear motion control system on bicycles using voice commentscan move in the correct gear position. Storage of voice commands is done 7 times and repetition of the same command nolater than 4 times while the fastest 2 times repetition. Test results in a crowded condition obtained 70% success and an average delay of 1.38 seconds and the test results in a quiet state obtained success of 80% and an average delay of 1.20 seconds.**

***Keywords*— voice recognition, rear derailleur, microcontroller, microphone, wireless, mountain bike, servo motor, soundlevel meter.**

I. INTRODUCTION

The development of the derailleur system technology is more rapid. In the 1970s the derailleur system could reach 7-speed levels with level gears, the driving system was an important factor in the gear regulation of the driving system connected through a lever called a shifter that was placed on the handle component and controlled by the driver simply by pushing the shifter lever with fingers. The shifter is then connected to a wire cable or wire that is an intermediary that pulls the derailleur front and rear derailleur intending to move the chain [1]. The bicycle that is often found in Mountain Bike (MTB) has a shifter system attached to the handlebar, then David Schneider makes an electronic rear gear shift [2] A bicycle mechanic from Oregon designs a home-made electronic bicycle shifter with a fall strategy by modifying a standard back of teeth (derailleur), releases a spring and replacing one side of the teeth (derailleur) with a bracket that holds the radio-control servo. [3]. Therefore, an automatic gear system design is made using sound identification. Speech recognition is a process carried out by the computer to identify the sound spoken by someone without regard to the identity of related people [4].

II. METHOD

This section describes the type of research, research design, system design, preparation of tools and materials, as well as the determination of procedures and parameters for using facilities from "Design Of Building Gear Motion Control Systems On Bicycles Using Voice Comments".

A. Research Design

The research design was created to detail the stages of making tools until the testing was carried out so that the results obtained in a collapsed research design that would be carried out in making the system. Literature study is the process of searching for information and studying all tools and materials to be used in making systems such as component characteristics, component needs, component costs, componentavailability to the estimated component layout. In this plan, the hardware and system planning include determining the device's design and the expected data output system. System design is in the form of planning stages in making a working design from the system. System implementation is the stages in making the system in accordance with the design that has been made starting from the microcontroller program to the mechanical and electrical. The fifth stage, system testing is the process of testing the system where the system will be tested on whether it runsas planned or not, the work system analysis is carried out to see the success of the program working in accordance with the planned system. The system checks the existingsystem whether it has been running or not, if the system runs but is not in accordance with the design of the systemthat has been made it will return to the system design stagere to -ensure. If the system is in accordance with the design of the system, it can be continued to the next stage. Work system analysis is the stage that analyzes the work systemregarding the program running as planned. If the system is inaccordance with the planning, the system is complete. The research design diagram is displayed in Fig. 1 below:

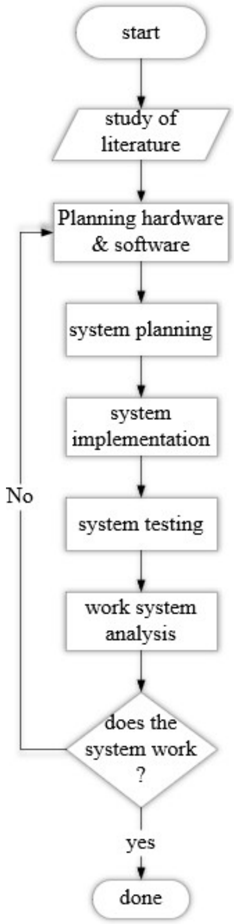

Figure 1. Research Design Diagram

B. *System Planning*

The design that will be made to facilitate systemdesign requires a system block diagram, in this study shown in Fig. 2 which is a block diagram rather than the design of the bicycle gear motion control system using Voice Comment.

Humans operate tools in the bicycle gear motion control system using voice comments. Then the wireless microphone will arrest the sound sung by the user or human. The Voice Recognition Module will be trained toidentify the sound that will be used. Library from Voice Recognition [1][5] Module is a storage area for voice identification data. Then the microcontroller functions for the servo motion program to move according to the sound command. The servo will move the rear shifter cable accordingto the command [2][6]. Battery as a power supply to run a microcontroller and voice recognition. and LCD as an indicator that the shifter can work and know the position of the shifter's electric motion.

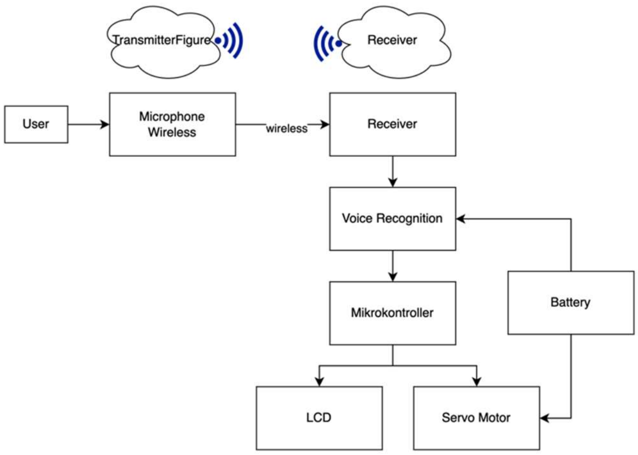

Figure 2. System Blog Diagram

Flowchart Diagram Voice Training on Voice Recognition Module shown in Fig.3 below. The sound will be received by the microphone then the incoming sound signal will be changed into digital form.Then inputted on Libary to make the command template on the system. The data that has been stored if you want to change it will be deleted and then there will be a repetition of the command [3][7].

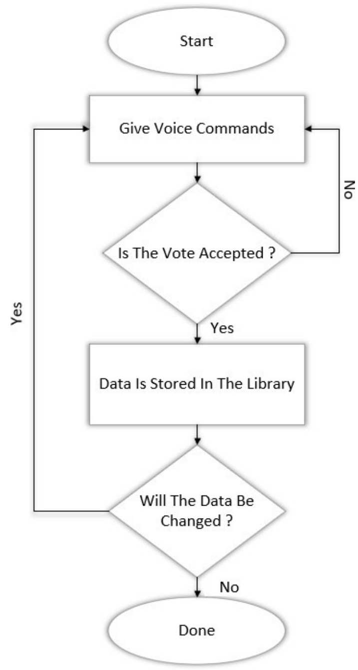

Figure 3. Flowchart Diagram Voice Training on Voice Recognition Module

C. *Flowchart of Practice*

The following is a description of the System Design Flowchart diagram shown in Fig. 4.

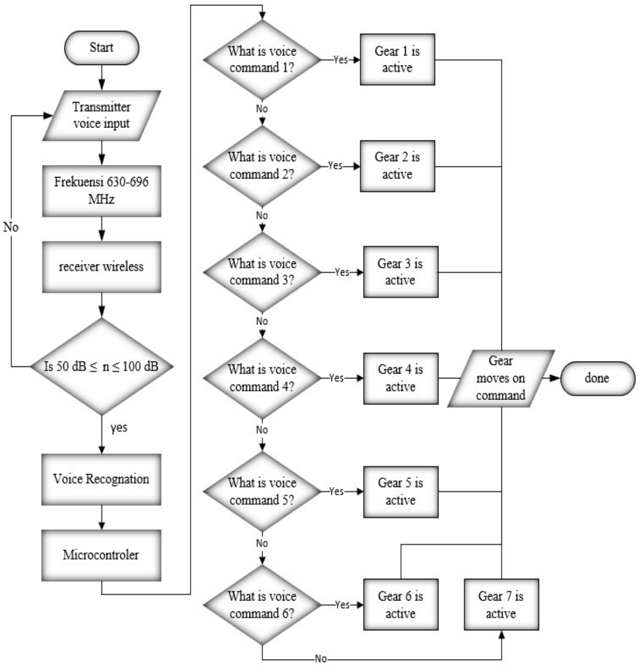

Figure 4. System Design Flowchart

Humans give the command to change the sound. The sound will be emitted by a Wireless microphone. Wireless microphone frequency of 630 - 696 MHz. Then the sound will be received by the microphone receiver that has been installed on the voice recognition module. The voice module then identifies whether the sound received by the library has been stored or not. Themicrocontroller [8][9]. then boosted the servo according to thecommand that was available in the command in gear position one it would move in position one and soon [10][11].

D. Hardware Design

From the left is the voice recognition module that will store and receive voice commands from the user or user. Then the microcontroller functions as a motion regulator on the servo motor and the display of the LCD. Then the LCD [12] functions as an indicator of the gear position, so that it can find out where the gear location is on the road. The servo motorbike is a controller of gear motion, the inter-cable that is connected to the rear derailleur will be pulled by the servo motor. The 18650 battery functions as a power supply for microcontrollers and servo motors [13][14].

E. Results And Discussion

Here are the tools and materials needed as shown in table.

TABLE 1
TOOLS AND MATERIALS NEEDED

Tools name	Total
Voice Recognition Module(VRM)	1
Microcontroller	1
Mountain bike	1
Battery	6
LCD	1
Servo motor	1
Step up dc to dc	1
charging module	2
Sound level meter	1
Wireless UHF Microphone HX-W002	1

III. RESULT AND DISCUSSION

Following are the results of the image of the servo connection with the rear derailleur visible from the side, it can be seen that the rear derailleur [15] is pulled and pushed by the servomotor in the same direction and opposite the clock, the servo motorbike is connected receiver module, and in the receiver module, there is a voice recognition that stores data library data.

Figure 5. System Design Flowchart

Following are the results of the implementation of the receiver module on the steering wheel appear dead and the stateturns off as shown in the picture, visible LCD [8], and 6 batteries that have been installed with the charging module divided intotwo sources and on the left side for the servo motor power supply [16].

Figure 6. System Design Flowchart

Receiver Implementation Results In Open conditions in the receiver module there are voice recognition and a microcontroller to store sound commands [12], while the receiver image receives sound from the transmitter contained in the helmet.

Figure 7. System Design Flowchart

A. *Voice Storage Test Results on Voice Recognition*

In this storage test, an experiment was carried out up to 7 times to do the test whether the sound could be saved by the voice recognition module [9].

Results	Notes
sigtrain 0 satu Record: 0 Speak now Record: 0 Speak again Record: 0 Cann't matched Record: 0 Speak now Record: 0 Speak again Record: 0 Success Success: 1 Record 0 Trained SIG: satu	succeed
sigtrain 1 dua Record: 1 Speak now Record: 1 Speak again Record: 1 Success Success: 1 Record 1 Trained SIG: dua	succeed
sigtrain 2 tiga Record: 2 Speak now Record: 2 Speak again Record: 2 Cann't matched Record: 2 Speak now Record: 2 Speak again Record: 2 Success Success: 1 Record 2 Trained SIG: tiga	succeed
sigtrain 3 ember Record: 3 Speak now Record: 3 Speak again Record: 3 Success Success: 1 Record 3 Trained SIG: ember	succeed
sigtrain 4 lima Record: 4 Speak now Record: 4 Speak again Record: 4 Cann't matched Record: 4 Speak now Record: 4 Speak again Record: 4 Success Success: 1 Record 4 Trained SIG: lima	succeed
sigtrain 5 enam Record: 5 Speak now Record: 5 Speak again Record: 5 Success Success: 1 Record 5 Trained SIG: enam	succeed
sigtrain 6 tujuh Record: 6 Speak now Record: 6 Speak again Record: 6 Success Success: 1 Record 6 Trained SIG: tujuh	succeed

The sound given must be clear in terms of intonation and pronunciation of the sentence, known in the first experiment of the voice recognition module repeating the same sentence up to 4 times. In the second experiment, the voice recognition module repeated the same sentence 2 times [13].

B. Testing on Gear

In this test, the experiment was carried out up to 7 times to whether the gear moved according to the correct state [10].

1	2	3	4	5	6	7	Degree of servo
V							150°
	V						142°
		V					138°
			V				130°
				V			121°
					V		119°
						V	108°

In the first command, the experiment can move in the first gear position with the command delay until the gear moves are 1.77 seconds. In the second command, the experiment can move in the second gear position with the command delay until the gear moves are 01.43 seconds. In the third command, the experiment can move in the third gear position with the command delay until the gear moves are 01.11 seconds. In the experiment, the fourth command can move in the fourth gear position with the command delay until the gear moves are 01.26 seconds. In the fifth command, the experiment can move in the fifth gear position with the command delay until the gear moves are 1.56 seconds.In the sixth command, the experiment can move in the sixth gear position with the command delay until the gear moves are 01.13 seconds. In the seventh command, the experiment can move in the seventh gear position with the command delay until the gear moves are 01.32 seconds [11].

C. Testing when Crowded

In this test, the experiment was carried out up to 10 times to test whether the gear moved according to the command. In the first experiment, the results of failure were found in gear position 2 with an average delay of 01.77 seconds, in the second experiment the results of failure were found in gear positions 3 and 4 with an average delay of 01.43 seconds, in the third experiment the results of failure in the gear position 7 with an average -Rata delay 01.11 seconds, in the fourth experiment a failure results were found in gear position 2.3, and 4 with an average delay 01.26 seconds, in the fifth experiment the results of failure in gear position 3 with an average delay 01.56 seconds, in the sixth experiment The results of failure were found in the gear position 2.4, and 6 with an average dela 01.13 seconds, in the seventh experiment the results of failure in gear position 2 with an average delay of 01.32 seconds, 4, and 6 with an average delay of 01.77 seconds, in the ninth experimentthe results of failure were found in gear positions 2.3, and 6 with an average delay 01.43 seconds, in the tenth experiment was not obtained will fail with an average delay 01.11 seconds.Based on the results of the testing that has been carried out, it can be analyzed that the command sentence 2 is not detected due to intonation and pronunciation similar to "two" and "twohh" because the voice recognition module is very sensitive to different sentences and different intonations.

experiment	Position on gear							
	1	2	3	4	5	6	7	Average delay
1	V	X	V	V	V	V	V	01.77 second
2	V	V	X	X	V	V	V	01.43 second
3	V	V	V	V	V	V	X	01.11 second
4	V	X	X	X	V	V	V	01.26 second
5	V	V	X	V	V	V	V	01.56 second
6	V	X	V	X	V	X	V	01.13 second
7	V	X	V	V	V	V	V	01.32 second
8	V	X	X	X	V	X	V	01.77 second
9	V	X	X	V	V	X	V	01.43 second
10	V	V	V	V	V	V	V	01.11 second

D. Testing when it is Quiet

In this test, the experiment was carried out up to 10times to test whether the gear moved according to the command.

experiment	Position on							
	1	2	3	4	5	6	7	Average delay
1	V	X	X	V	V	X	V	01.77 second
2	V	V	V	V	V	V	V	01.43 second
3	V	V	V	X	V	V	V	01.11 second
4	V	X	V	V	V	V	V	01.26 second
5	V	V	V	X	V	X	V	01.56 second
6	V	X	X	V	V	X	V	01.13 second
7	V	V	V	V	V	V	V	01.32 second
8	V	X	X	X	V	X	V	01.77 second
9	V	X	X	V	V	V	V	01.43 second
10	V	V	V	X	V	X	V	01.11 second

10 times the experiment and 7 commands in one experiment obtained the results as in the table, in the first experiment the results of failure were found in gear positions 2.3 and 6 with an average delay of 01.77 seconds, in the second experiment there were no failure results with an average delay of 01.43 seconds, in the third experiment failure results, were found in the gear 4 positions with an average delay of 01.11 seconds,in the fourth experiment the results of failure in the gear position 2 with an average delay of 01.26 seconds, in the fifth experiment the results of failure in the gear position 4 and 6 with an average delay 01.56 seconds, in the sixth experiment the results of failure were found in gear positions 2.3 and 6 with an average delay 01.13 seconds, in the seventh

experiment the results of failure with an average delay 01.32 seconds, in the eighth experiment The results of failure were found in the gear position 2,3,4, and 6 with an average delay of 01.77 seconds, in the ninth experiment the results of failure in the gear positions 2 and 3 The average delay 01.43 seconds, in the tenth experiment the results of failure were found in gear positions 4 and 6 with an average delay of 01.11 seconds. Based on the results of the testing the lap in a quiet state is more successful because the noise received is lessthan when the crowded voice recognition module is very sensitive to the noise from the environment [15].

IV. CONCLUSION

Based on the results of the research on the design of the gear motion control system on bicycles using this voice comment, the following conclusions can be drawn: Based on the sound storage test on voice recognition, it works well, the voice storage is done a maximum of 7 times and the longest repetition of commands is up to 4 times and the fastest is to repeat 2 times. Testing the success of the gear position driven by the servo goes well, the position on gear "one" is at 150° degrees of the servo motor, then at position "two" it is at 142° degrees of the servo motor, at position "three" it is at 138 ° degrees servo motor, at position "four" is at 130° degrees servo motor, at position "five" is at 121° degrees servo motor, at position "six" is at 119° degrees servo motor, at position "seven" is at 108° degree servo motor. The test results when conditions are quiet get an average command success of 80% with an average delay of 1.20 seconds because when testing in a quiet place there is less noise, and the results obtained are better. The test results when it is quietly get the maximum voice command level of 96.1 dB. The test results in crowded conditions obtained an average success rate of 70% with an average delay of 1.38 seconds because in busy conditions there is a lot of noise. The results of the test when it is crowded, the maximum level of voice commands is 101.9 dB. The difference between the maximum crowded conditions and the maximum quiet conditions is 5.8 dB. and the difference between the minimum crowded conditions and the minimum quiet conditions are 7.9 dB.

REFERENCES

[1] Ananda Stephanus Antonius, & Putro Iwan Handoyo. (2017). Studi Penggunaan Energi pada Monitor *CRT* dan*LCD*. Jurusan Teknik Elektro, Fakultas Teknologi Industri, 121-131.

[2] Andriana, & Setiyono Riyanto. (2015). Simulasi *SpeechRecognation* Untuk Sistem Keamanan Strater Mobil. Teknik Elektro Universitas Langlangbuana, 4, 53-63.

[3] Andriana, Olly Vinicius, Riyanto, Ganjar, & Zulkarnain. (2016). *Speech Recognation* Sebagai Fungsi *Mouse*. *jurnal.umj*.

[4] Chen hou shin, & gao wen. (2010). *Spectrum Sensing for FM Wireless Microphone Signals*. *ieee symposium on newfrontiers in dynamic spectrum* , 1, 12-20.

[5] Forouzesh Mojtaba, Siwakoti, Yam., Gorji, Saman., Blaabjerg, F., & Lehman, B. (2017). *Step-Up DC–DC Converters: A Comprehensive Review of Voltage-Boosting Techniques, Topologies, and Applications. Ieee Transactions On Power Electronics,* 30(12), 9143 - 9177.

[6] Gaikwad Vishal, Joshi Prathiba, Mudaliar Yutja, Naik Aswini, Gudal Aditya, & Bhandari Shumba. (2020). *Optimizing Power Consumption for Solar Powered Rechargeable Lithium Ion (Li-ion) Battery Operated IoT Based Sensor Node Using WeMos D1 Mini*. *Emerging Smart Computing and Informatics (ESCI)*, 12 - 14 .

[7] Ismail Ahmad Yusuf, Mat Nuri, Nur Rasyid, Mansor Mazlad Ahmad, Shukri M. Amirul, & Afiq Ahmad. (2015). *Study On The Road Transmitted Vibration Of A Mountain Bicycle*. Jurnal Teknologi*, 77:21*, 27–31.

[8] Maria jose. (2015, oktober 13). *Simple way to life. (proudly powered by wordpress) retrieved may 1, 2022, from http://blog.unnes.ac.id/antosupri/liguid-crystal-display-lcd-16-x-2/*

[9] Murphy enda, & king eion. (2016). *Testing The Accuracy Of Smartphones And Sound Level Meter Applications For Measuring Environmental Noise*. *applied acoustic,* 106, 16 - 22.

[10] Natanael Feldo. (2019). *Compatibility Drive Train Parts* di PT Insera Sena Sidoarjo. Jurnal Titra*,* 7(2), 111–116.

[11] Putri Hasana, Nasution Randi Yusuf, & Hariyani Yusuf S. (2015). Perancangan dan Implementasi Tuner Gitar Otomatis Dengan Penggerak Motor Servo Berbasis Arduino. Jurnal Elektro Telekomunikasi Terapan.

[12] Rahayu Anita, & Hendri. (2020). Sistem Kendali RumahPintar Menggunakan *Voice Recognition Module V3* Berbasis Mikrokontroler dan IOT. Jtev (Jurnal Teknik Elektro Dan Vokasional), 06.

[13] Ruan winda, & Man talog. (2021). *arduino official store.(aduino productions) Retrieved mei 2, 2022, from https://store-usa.arduino.cc/products/arduino-uno-rev3?selectedStore=us*

[14] Saponara Sergio, Moras Ricardo, Roncella Roberto, Saletti Roberto, & Benedetti David. (2016). *PerformanceMeasurements of Energy Storage Systems and Control Strategies in Real-world e-bikes. Universit`a di Pisa*.

[15] Schneider David. (2013). *Ride by Wire Build a push button controlled electronic bicycle shifter on the cheap.Spektrum Industri, 12*, 113 – 247.

[16] Shinar Josep, & Shinar Ruth. (2008). *Organic light-emitting devices (oled) and oled-based chemical and biological sensors: an overview. Applied physics, 41*, 13.