Research report

Electric bicycle preventive control handle and static brake detection system

Executive summary

As a convenient short-distance transportation, e-bikes have been widely used in cities and villages. However, in recent years, due to

The frequent occurrence of traffic accidents caused by one-handed riding and brake failure has brought serious safety hazards to the society. In order to solve this problem, this project proposes to develop a set of e-bike one-handed handle bar and static brake monitoring system, which can monitor the riding status and brake performance in real time through intelligent technical means, warn in advance and effectively prevent accidents, and improve the safety and reliability of e-bikes.

The core technology of this project includes two modules: one-handed handlebar monitoring and static brake monitoring. The single-handed handlebar monitoring module adopts multi-sensor fusion technology, combining pressure sensors, photoelectric sensors and capacitive sensors, and monitors the hand grip status in real time through intelligent algorithms, accurately recognizes one-handed riding behavior, and automatically triggers an alarm or a speed reduction function when an abnormality is detected. The static brake monitoring module, on the other hand, detects the stretched length of the brake line and the wear of the brake pads through high-precision sensors, assesses the brake performance in real time, and completes a safety check before the vehicle is started to detect potential faults in advance.

In addition, the system also integrates the BeiDou positioning module and communication function to monitor the position, speed and battery status of the vehicle in real time, and send early warning information to the user through the vehicle display or cell phone APP. The system meets the requirements of the new national standard on the safety performance of electric bicycles, and is characterized by intelligence, high precision, low power consumption and high reliability.

With the continuous growth of e-bike ownership, its safety performance has been widely concerned. The implementation of the new national standard puts forward higher requirements for the dynamic monitoring and safety warning functions of vehicles, providing clear policy support for this project. Market research shows that consumers' demand for the safety and intelligence of e-bikes is increasing, especially the demand for vehicle safety monitoring on shared travel platforms is more urgent. This project fills the market gap through technological innovation, and has significant market potential and competitive advantages.

The project's business model includes cooperating with e-bike manufacturers to front-load the monitoring system as a standard feature of their vehicles; cooperating with shared mobility platforms to provide safety monitoring solutions for their vehicles; and selling the monitoring system to individual users through the aftermarket. In addition, the project will expand profit channels through data services and value-added services, such as providing traffic data support for urban traffic management departments and risk assessment data for insurance companies.

The project of one-hand control handle and static brake monitoring for e-bikes effectively solves the safety hazard problem of e-bikes through intelligent technical means, which has significant social and economic benefits. The project team will promote the smooth implementation of the project by virtue of its technological innovation and marketing capabilities, provide strong protection for the safe travel of e-bikes, and contribute to the sustainable development of the industry.

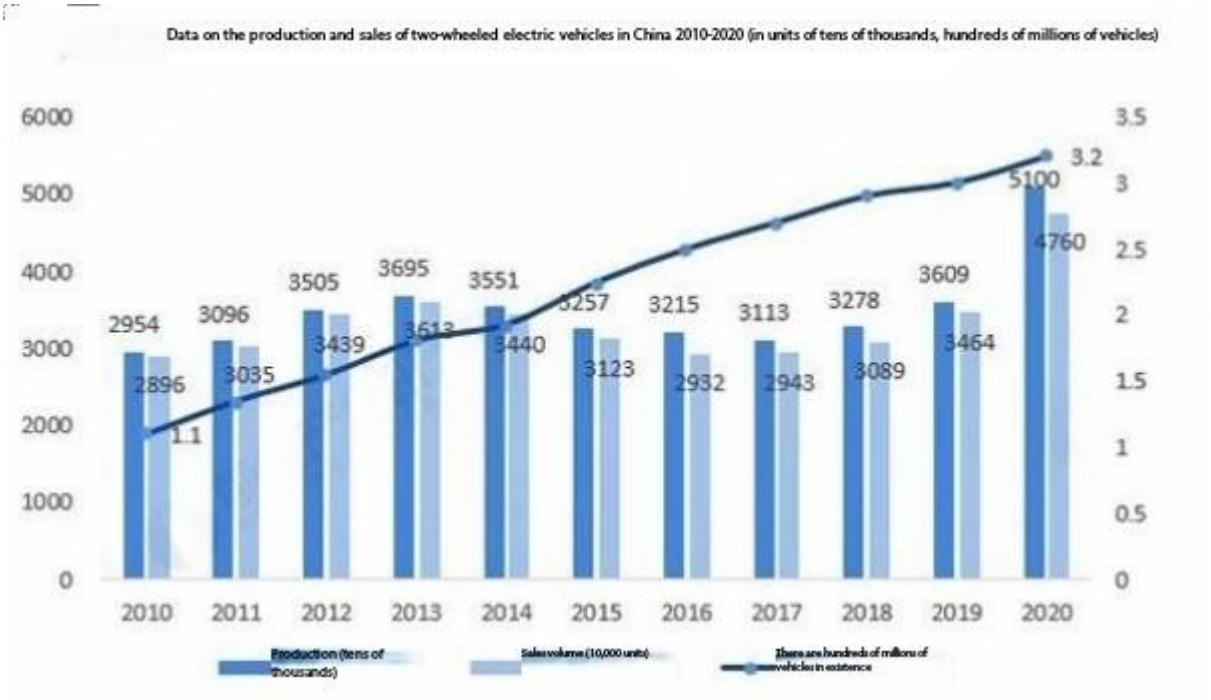
catalogs

I. Background of the project

1.1 Popularization of electric bicycles

The popularity of e-bikes continues to rise in China through 2025. According to the China Bicycle Association According to the disclosed data, by the end of 2022, the social ownership of electric bicycles in China had reached 350 million units. In addition, by the end of 2023, the number of two-wheeled e-bikes in China had reached 420 million. This indicates that e-bikes have become one of the important means of transportation for urban residents in China.

Globally, e-bike penetration is also increasing. For example, Germany's e-bike penetration rate reaches 24.7% in 2024, up from 23.3% in 2023. In addition, the market share of e-bikes in Belgium will exceed 50% for the first time in 2024, surpassing that of traditional mechanical bicycles. As an environmentally friendly and convenient means of transportation, e-bikes have become one of the main means of travel in both urban and rural areas. However, with its widespread use, riding safety issues are becoming more and more prominent. Among them, one-handed handlebar control and static brake failure are one of the major causes of accidents.



1.2 E-bike accidents are frequent

E-bike accidents account for a high proportion of all non-motorized vehicle accidents. According to the "China E-bike Preventive Driving Report" released by Pinecone Think Tank, from 2016 to 2023, China's e-bike accidents have increased for five consecutive years, and the current e-bike traffic accidents account for 75% of all non-motorized vehicle accidents. The average annual growth rate of traffic accident fatalities involving e-bikes is as high as 5.85%, with the number of e-bike fatalities increasing year by year on the premise that the number of fatalities in all modes of transportation has decreased.

1.3 Policy and market demand

1.3.1 "One helmet, one band" policy

In recent years, national and local governments have become increasingly strict on the safety management of electric bicycles, the relevant standards and regulations continue to improve. 2020 April, in order to effectively protect the motorcycle, electric bicycle riders and automobile drivers and passengers life safety, reduce traffic accidents and deaths, the Ministry of Public Security Traffic Management Bureau of the National Deployment of " a helmet with a " safety guard action. In April 2020, in order to effectively protect the lives of motorcycle and electric bicycle riders and car drivers and passengers, and reduce traffic accidents and deaths, the Traffic Management Bureau of the Ministry of Public Security deployed the "One Helmet, One Belt" safety guarding action across the country.

Ministry of Public Security of the People's Republic of China

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Home > Work Current > Main Page

Ministry of Public Security calls for prudent advancement of the "One Helmet, One Belt" security defense operation

Actively work with market regulatory authorities to strictly investigate illegal safety helmet prices

Time: 05 / 21 / 2020 Source: People's Public Security Daily Author: Cheng Linjie Fonts: Major and middle school 小 Share to:

In order to effectively protect the life safety of motorcycle, electric bicycle riders and car drivers and reduce traffic fatalities, the Transportation Management Bureau of the Ministry of Public Security has deployed a "one helmet, one area" safety protection operation across the country. In the operation, public security traffic management departments everywhere adhere to publicity and guidance as a first step, industry demonstration as a lead, and broadly involve the public. The public's awareness of wearing safety helmets and using seat belts has increased significantly. With the central release of demand for e-bike safety helmets, the price of safety helmet sold by some enterprises and platforms has soared. The Ministry of Public Security attached great importance to this issue, and took the initiative to communicate with the State Administration of Market Supervision and Administration, and guide the public security agency to actively cooperate with the market regulatory authorities to strictly investigate price violations according to law, and cut off the illegal chain of driving up helmet prices.

The Ministry of Public Security called on all places to prudently advance the "one helmet, one area" security defense operation. From June 1, law enforcement penalties are limited to not wearing a motorcycle

Since the '' one helmet, one belt'' safety guarding action, electric bicycle, motorcycle, automobile driver and passenger traffic accident fatality rate decreased by 11.7%, 14.2%, 12.4% year-on-year; electric bicycle d**river and** passenger deaths have decreased for the first time since 2006; the average use rate of automobile front seat belts in 36 major cities exceeded 90%, and the average wearing rate of electric bicycle safety helmets increased from less than 20% before the action to 54% at present. The average use rate of seat belts for front-row drivers in 36 major cities exceeded 90%, and the average wearing rate of safety helmets for electric bicycles increased from less than 20% before the action to 54% at present, with the wearing rate of safety helmets in some cities such as Ningbo reaching more than 90%. .....

In the " One Helmet One Belt" safety guarding action, public security traffic control

departments across the country adhere to the publicity and guidance first, combined with education and persuasion, industry demonstration and leadership, social co-operation, and effectively improve the level of safety and protection of electric bicycles, motorcycle riders and automobile drivers and passengers, and promote the prevention of road traffic accidents. The work of "reduction and control" has achieved new results.

1.3.2 Consumer demand for safety and intelligence

With the increasing awareness of environmental protection and the diversification of urban transportation needs, e-bikes, as a kind of green and convenient short-distance transportation, are favored by more and more consumers. However, consumers' demand for e-bikes is no longer limited to the traditional travel function, but pays more attention to its safety and intelligent level.

In terms of safety, consumers' attention to the safety configuration of e-bikes has increased significantly. For example, the new version of the Safety Technical Code for Electric Bicycles puts forward stricter requirements for key components such as batteries, brakes, reflective markings, etc., to ensure the stability and reliability of the vehicle in the process of use. In addition, intelligent safety features, such as vehicle positioning, abnormal alarm, TCS anti-skidding, etc., have also become the focus of consumers' attention. These features not only enhance the safety of riding, but also reduce the occurrence of accidents.

In terms of intelligent demand, consumers show strong interest in the intelligent functions of e-bikes. According to the data, more than 55.1% of consumers want e-bikes to have push assist and reverse functions, 46.7% of consumers are concerned about the alarm function, and 41.6% of consumers need the vehicle positioning function. These intelligent functions not only enhance the convenience of riding, but also realize real-time monitoring and remote management of the vehicle through the Internet of Things (IoT) technology.

The increase in consumer demand for safety and intelligence of e-bikes provides a broad market space for the development and promotion of preventive one-handed handle bar control and static brake monitoring systems.

II. Project investigations

2.1 Survey on one-handed handlebar control for electric bicycles

2.1.1 survey purpose

To design an electric bicycle handlebar that can intelligently reduce the speed when the driver drives the electric bicycle with one hand, in order to regulate the dangerous behaviors of riding the electric bicycle in people's daily life, so as to reduce the occurrence rate of traffic accidents.

2.1.2 Survey data

2.1.2.1 Survey of visit data

In order to understand whether there is one-handed riding electric car behavior in the process of people riding electric cars in daily life, and whether there is a need for an automatic detection of electric cars can not hold the throttle device with one hand. The team went on the street, respectively, to 450 residents to make a survey, of which 150 people who were sweeping the car at the shared electric car parking spot, small

There are 300 residents in the district who go out on motorized bicycles.

	Have you ever seen a one-handed motorized bicycle? phenomenon	Need a way to detect electric vehicles that don't One-handed throttle control
Kenji Corporation (Hong Kong company) Karma Center, Park East Middle School who is sweeping the car (150 persons)	150 people have seen it all.	128 said all, 22 Say it's not necessary.
Cinnamon (brand) Residents of the neighborhoods such as Garden, Yakul, and Dongjiang Bay	280. I've seen them all.	235 said yes, 45 said yes. unnecessary

(300 persons)		

Through the research and analysis of e-bike riding behavior, it was found that the phenomenon of residents riding e-bikes with one hand controlling the handlebars is more common, the main reasons for this are: firstly, some residents need to pick up and drop off children or carry more items in the process of riding, which leads to the inability to control the handlebars with both hands; secondly, some residents are unfamiliar with the routes or overly rely on the navigation of the cell phone, which distracts the attention of the rider. This one-handed riding behavior significantly increases traffic safety risks.

In order to improve riding safety, the majority of residents felt that it was necessary to install a device to prevent one-handed handlebar control behaviors from occurring. However, there were still a few residents (6) who said they did not need such a device in the study. Further analysis revealed that three of them felt that the device limited their ''cool'' behavior when riding with one hand, while the other three felt that the device was not necessary for the safety of one-handed riding.

3 people had to ride single-handed due to practical needs (if they needed to maneuver items with one hand).

2.1.2.1 Physical observation statistics

In order to get further data, the team members went to the entrances and exits of the neighborhood and the nearby parking spots of the shared electric bike to observe each for one hour, in addition to counting the number of users who ride the bike with one hand, the team also made quantitative statistics for the situation of the reasons why people ride the electric bike with one hand. The results are as follows:

	neighborhood	parking spot	total number of people
Buy menu hand ride rook (in Chinese chess)	38	56	94
Single-handed with child cycle	13	2	15
Looking at a cell phone one-handed cycle	54	47	101
Other One-handed cycling	28	16	44

The data shows that one-handed cycling is more common at the entrances and exits of neighborhoods and shared parking spots, with a total of 254 trips, of which " looking at the cell phone" and "shopping for groceries" are the main reasons, accounting for 40% and 37%, respectively.

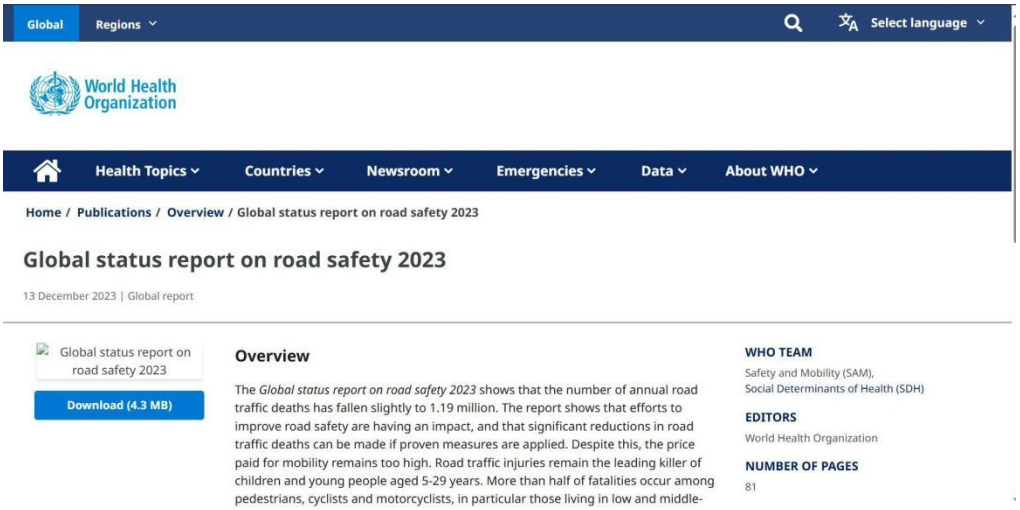
There are differences in the reasons for one-handed cycling in different scenarios, but in general they reflect the contradiction between convenience and safety in cycling for residents. For example, grocery shopping and bringing up children are more often motivated by practical needs, while checking the phone and playing handsome are more habitual or non-essential risky behaviors. Given the high prevalence and potential dangers of one-handed cycling, it is necessary

to reduce the occurrence of such behaviors through technical means (e.g., one-handed handlebar monitoring devices) and publicity and education (e.g., traffic safety seminars). Especially for behaviors such as "looking at cell phones" and "playing handsome", safety awareness education should be strengthened to guide residents to develop good riding habits.

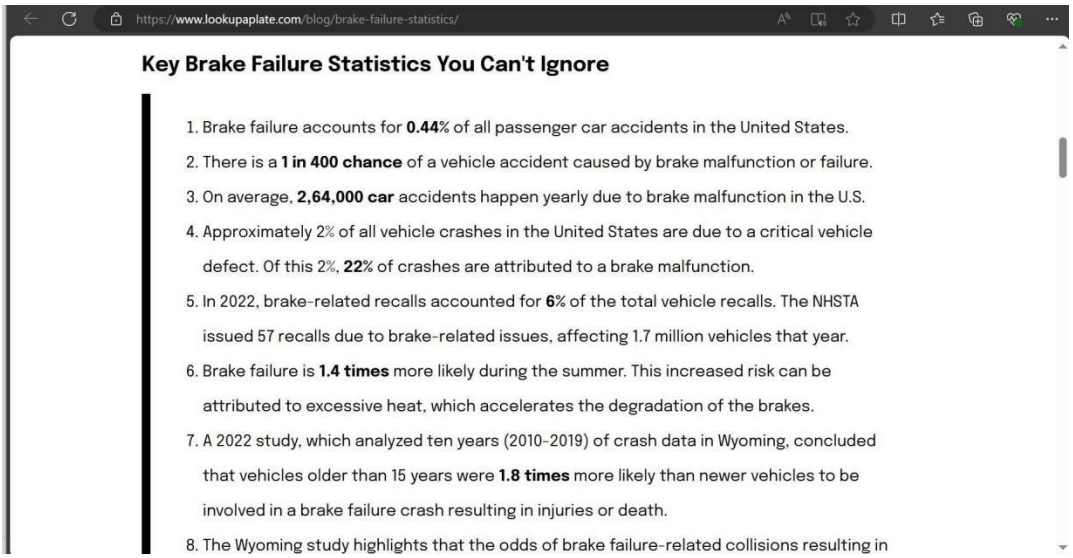
2.2 Investigation on the problem of brake failure

2.2.1 Background and purpose of the survey

According to the World Health Organization (WHO), in 2023, about 1.19 million people will die each year in traffic accidents worldwide. Brake failure is one of the major causes of traffic accidents and according to the data, about 22% of traffic accidents are caused by brake failure.



Brake failure is more common in trucks at 30%, according to lookupA plate's search site: 13 Shocking Brake Failure Statistics That Drivers Can't Ignore (lookupaplate.com).



2.2.2 survey purpose

A static brake detection system is designed to be more applicable on shared electric bicycles. Before the driver rides the bicycle, the driver is able to obtain the hundred percent data of the loss degree of the brake skin, so that the brakes of the vehicle can be known in advance, thus avoiding traffic accidents due to brake failure of the driver to ensure the safety of driving.

2.2.3 Survey data

In order to find out whether people riding electric bicycles in daily life in the process of single-handed brake failure situation, whether a static bicycle brake detection device is needed. The team took to the streets and surveyed 168 residents to find out if there is a need for a static bicycle brake detection device.

The investigation was carried out, including 83 investigators at Taipinggu Street in Yuancheng District and 85 residents who went out on bicycles in the neighborhood.

	I've had bikes with brake failure. position	Need a static bicycle brake sensor
Taiping Ancient Street, Yuancheng District	32 people have encountered	78 said yes, 5 said no need
Cinnamon Garden, Yajuile, Dongjiang Bay et al. (and other authors) neighborhood	36 persons encountered	71 said yes, 14 said no need

Figure 1 Map of the visit site

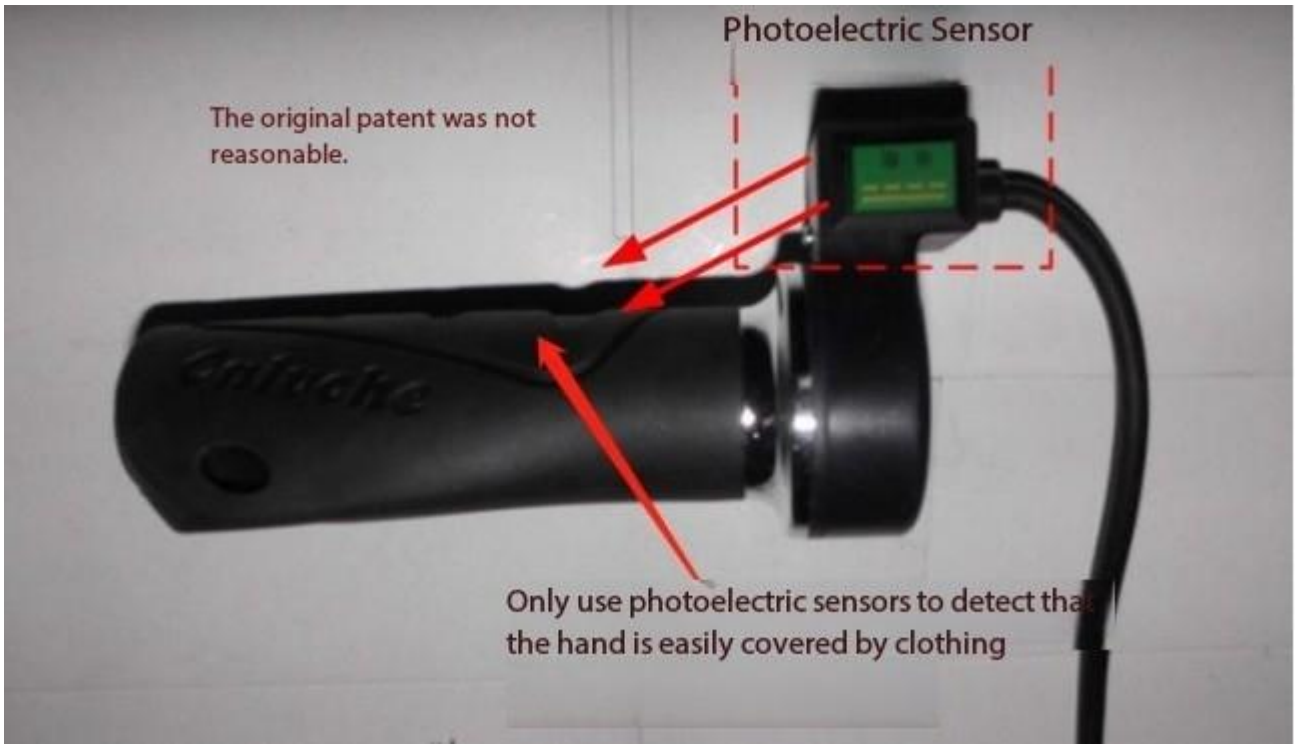
A survey of e-bike riders found that the majority of respondents had experienced brake failure during their daily trips, a phenomenon that significantly increases the risk of cycling safety. In order to improve travel safety, the majority of respondents believe that it is necessary to install a brake monitoring device to protect their own safety and the safety of others. However, during the survey, there were still 19 people who said they did not need such devices. Further analysis revealed that 11 of them believed that

While the other 8 respondents would not experience brake failure on their own, the other 8 respondents had a low level of safety awareness and believed that they would be able to stop the vehicle on their own even if the brakes failed. This perception ignores the serious consequences of brake failure, such as losing control of the vehicle, falling down, or even causing a traffic accident.

2.3 Problems with similar products

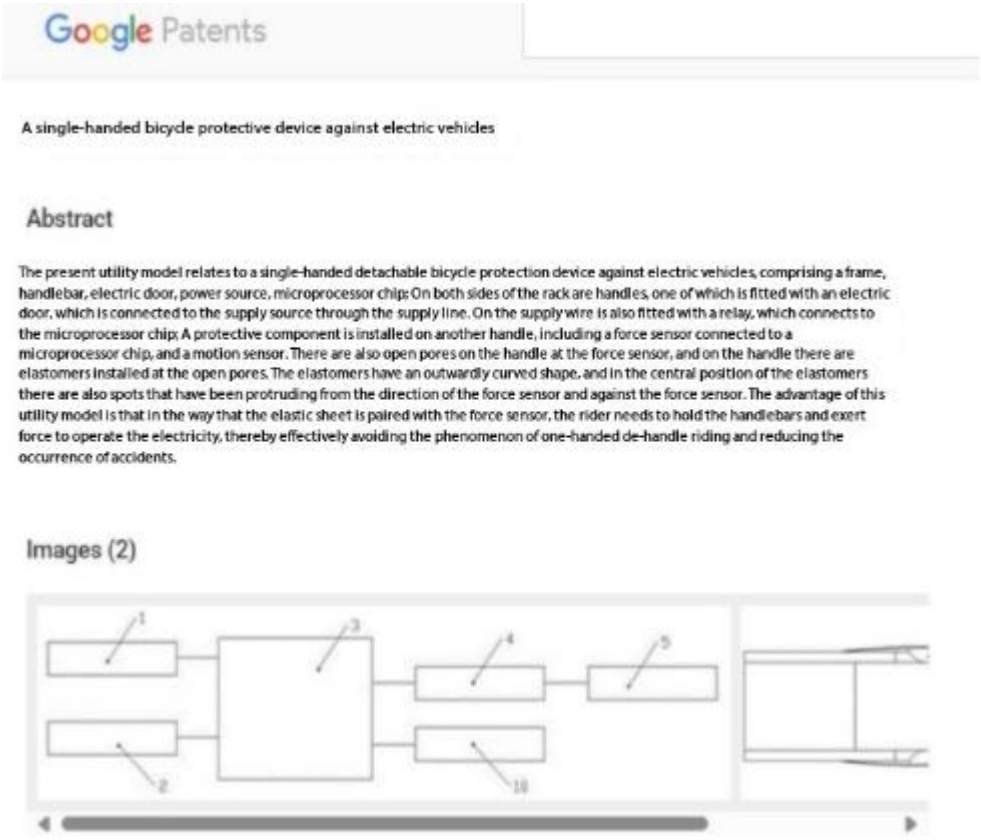
2.3.1 Disadvantages of the one-handed handle protection system

2.3.1.1 Photoelectric sensors have drawbacks



In the original e-bike safety monitoring patents, there are obvious limitations in the scheme of using photoelectric sensors to detect the position of both hands on the handlebar. On the one hand, the detection range of the photoelectric sensor is limited, only covering a localized area of the handlebar, and it is difficult to comprehensively monitor the dynamics of the hands. On the other hand, the detection principle of the photoelectric sensor is based on the obstruction or reflection of the light beam by the object, which is easily affected by obstructions such as clothing and gloves, leading to misjudgment or omission. This detection method may not be able to accurately determine whether the rider is controlling the handlebar with both hands in practical applications, thus reducing the reliability and practicality of the system. Therefore, it is necessary to further optimize the sensor layout or adopt multi-sensor fusion technology to improve the detection accuracy and anti-interference ability to ensure that the safety monitoring system for electric bicycles can function effectively.

2.3.1.2 Significant technical limitations of single-handed handle protection systems



Google Patents

A single-handed bicycle protective device against electric vehicles

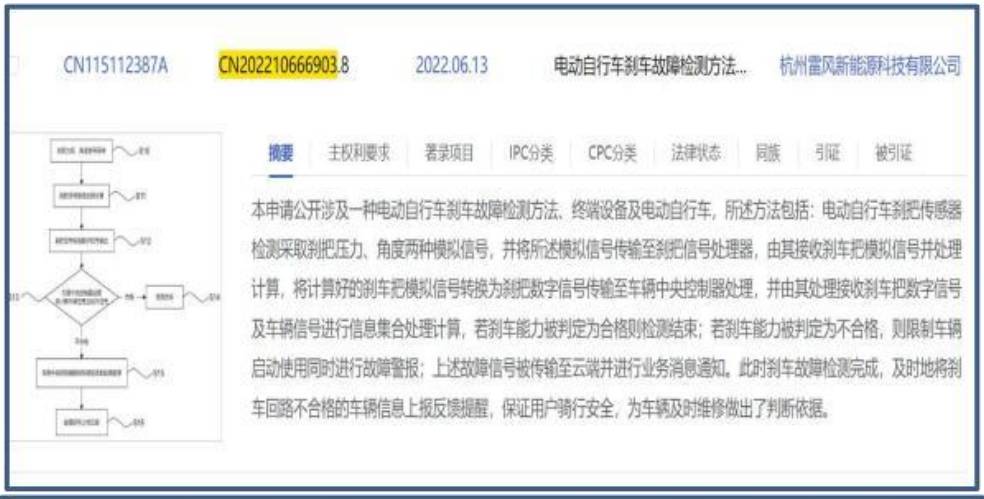
Abstract

The present utility model relates to a single-handed detachable bicycle protection device against electric vehicles, comprising a frame, handlebar, electric door, power source, microprocessor chip: On both sides of the rack are handles, one of which is fitted with an electric door, which is connected to the supply source through the supply line. On the supply wire is also fitted with a relay, which connects to the microprocessor chip; A protective component is installed on another handle, including a force sensor connected to a microprocessor chip, and a motion sensor. There are also open pores on the handle at the force sensor, and on the handle there are elastomers installed at the open pores. The elastomers have an outwardly curved shape, and in the central position of the elastomers there are also spots that have been protruding from the direction of the force sensor and against the force sensor. The advantage of this utility model is that in the way that the elastic sheet is paired with the force sensor, the rider needs to hold the handlebars and exert force to operate the electricity, thereby effectively avoiding the phenomenon of one-handed de-handle riding and reducing the occurrence of accidents.

Images (2)

The existing one-handed handlebar protection system for electric bicycles has significant technical limitations. On the one hand, the detection range of the pressure sensor is limited and only covers a localized area of the handlebar, making it difficult to comprehensively monitor whether the hand is actually gripping the handlebar. On the other hand, the pressure sensors are easily replaced by heavy or other objects to evade detection. In addition, some systems directly cut off the power supply when detecting one-handed driving. Although the rider can be forced to correct the behavior, this sudden power cut may cause the vehicle to lose power, leading to the rider losing balance and even causing safety accidents such as falls.

2.3.2 Brake testing is flawed



In the field of shared bicycles, some operating companies have submitted relevant patents to enhance the safety of the vehicles. For example, the above patent proposes a detection and control device for a shared bicycle, which collects the traveling acceleration of the vehicle by means of a speed monitoring module, and detects the stretched length of a brake line by using a brake condition monitoring module. The controller then evaluates the braking performance of the vehicle based on the above data. However, such technical solutions have limitations: they only monitor the brake status during the vehicle's driving, and if the driver only realizes that the brakes are out of order while riding, he or she may no longer be able to avoid a traffic accident. This suggests that the prior art is still deficient in preventive safety monitoring and needs to be further optimized to detect potential brake failures in advance, thereby reducing the risk of accidents.

III. Introduction to the project

3.1 "Driving with one hand" Intelligent Downspeed Electric Vehicle Technology

3.1.1 Design Ideas

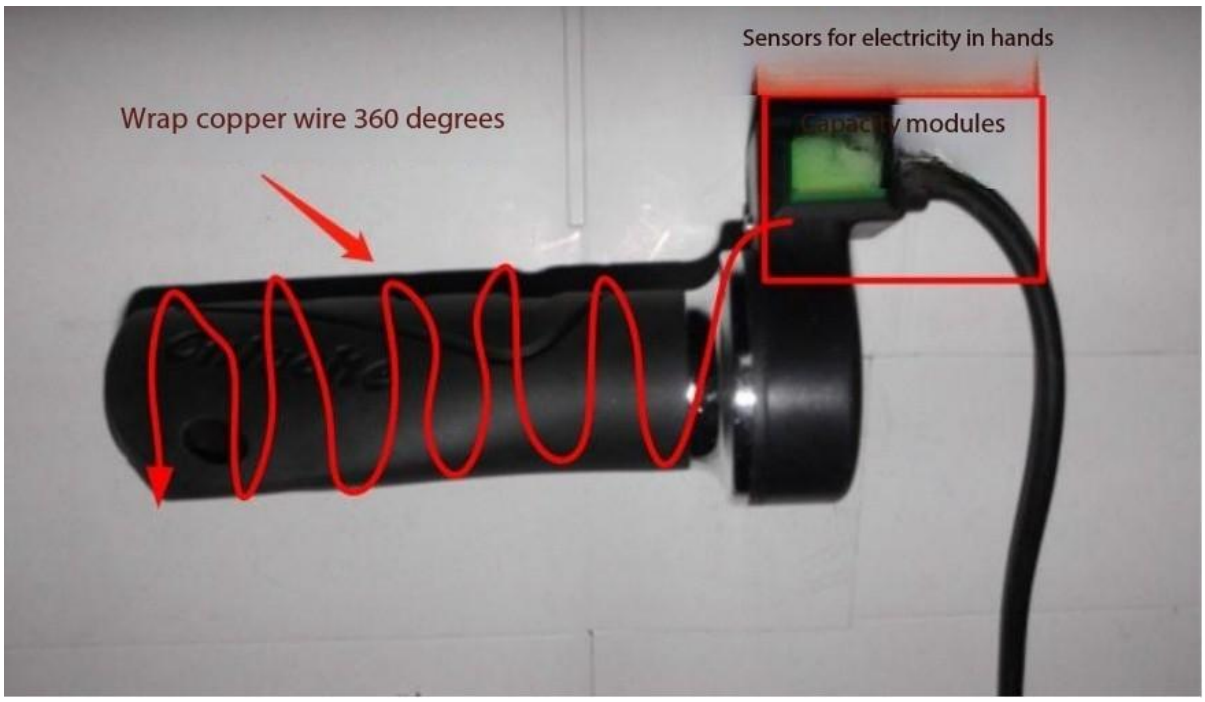


Figure 3-1 Product Design Diagram

Distinguished from the traditional photoelectric sensor detection technology of the new multi-point detection safety type electric car, the use of touch chip into the copper coil in the electric car handle, to achieve the purpose of multi-point detection, combined with the actual situation of people's daily riding an electric car, the use of capacitance button working principle, our team designed an automatic sensing electric car can not be one-handed grip throttle device. As long as this device is installed in the electric car's grip, when the user's hand on the grip when the electric car can accelerate, as long as the user's hand to release the grip when the electric car will slowly slow down, only when the user puts both hands on the grip when the electric car is allowed to accelerate. In this way, people can't ride the e-bike with one hand, which ensures people's safe driving and effectively reduces the accidents caused by riding the e-bike with one hand.

Figure 3-2 Product Program Diagram

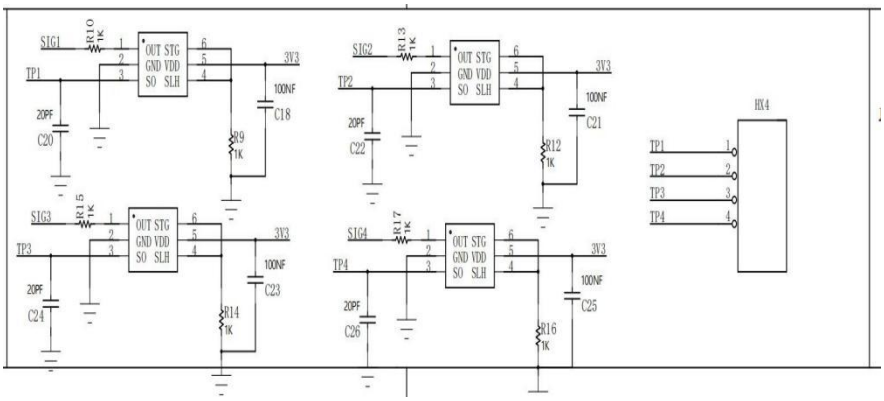


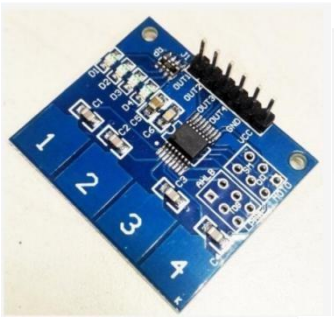
Figure 3-3 Handlebar Position Touch Chip Schematic

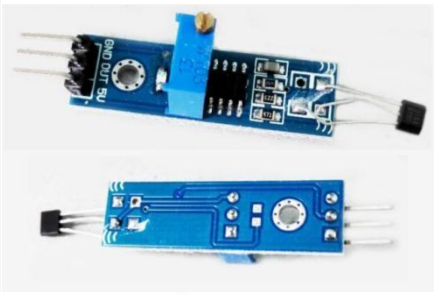
In the electric car handlebar winding with the coil on top of each handlebar with two groups of the same coil winding way, and ultimately the four groups of the same coil will be connected to the center of the controller above the touch capacitance module, when the four groups of the same coil all by the hand under the grip, will be all energized current directed to the touch module, only when the four touch modules are all detected by the hand pinched before the control of electrical appliances, to play another gear, that is, the high speed of the electric car gear, otherwise it will only cut to the NC low-speed gear, low-speed gear as mentioned above, there is a potentiometer. Otherwise it will only cut to the NC low-speed gear, low-speed gear above is as mentioned above there is a potentiometer, in general, these two functions are common to use a relay to control the speed of the electric car gear, so as to ensure that the driver's safety driving. Summarize when the driver mop driving words, the electric car will automatically cut into the low-speed gear electric car front and rear brake wear are less than 80% of the time, the electric car will also be cut into the low-speed gear at the same time, and vice versa are high-speed gear NO gear, high-speed gear is actually the electric car at the beginning of the initial speed range when the factory did not make additional settings.

3.1.2 Specific implementation process

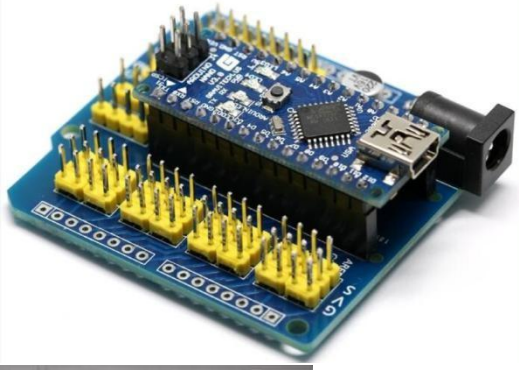
3.1.2.1 Prepared Materials

Four-position capacitive buttons, Hall sensors, servo drive mechanism and Nano main control board, electric handlebars.

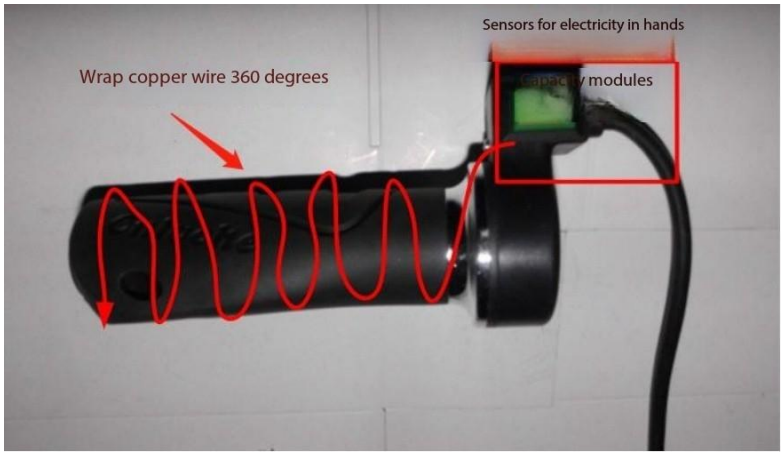





LH-S0090MD
棕：负极
红色：正极
橙色：控制



3.1.2.2 Gathering information and producing functional analyses



Utilizing the advanced four-position capacitance button and Hall sensor principle, the four-position capacitance button leads to two copper wires were wrapped around the handlebars on both sides of the electric car, and then through the four-position capacitance button induction servo to make the magnetic pole close to or away from the Hall sensor, so as to sense the driver's hand in the handlebars of the electric car not on the handlebars. Only when both hands are on the handlebars can the four capacitance buttons sense the servo so that the magnetic poles can sense the Hall sensors, which in turn can make the EV accelerate. As long as one hand is released from the handlebar, the four capacitors cannot sense the servo and thus cannot sense the Hall sensor, thus preventing the EV from accelerating.

3.1.2.3 Constant testing and three refinements

（1）First generation: wooden main plate and handlebars

Fig. 3 Appearance-making process

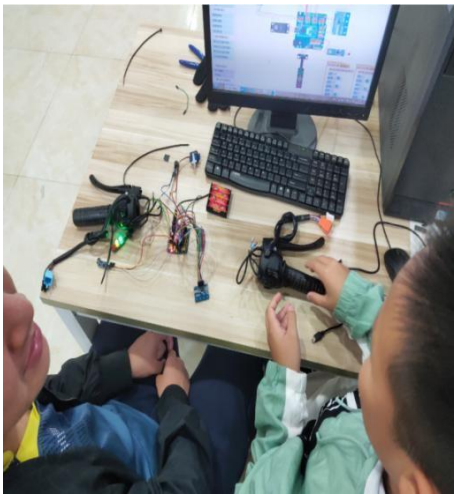


Figure 4 Device Wiring

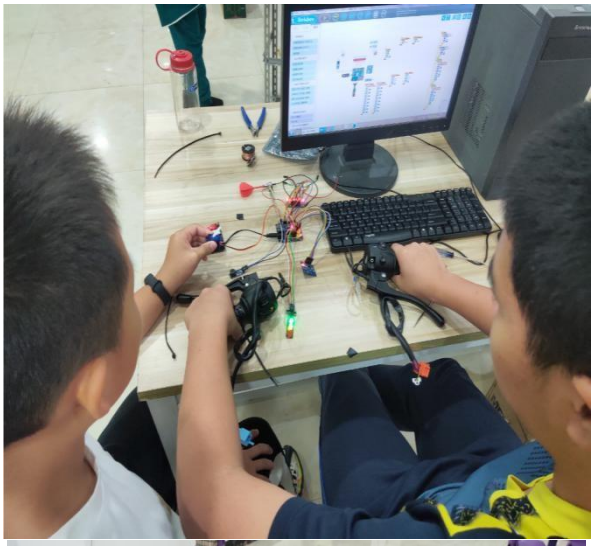


Figure 3 Functional Testing

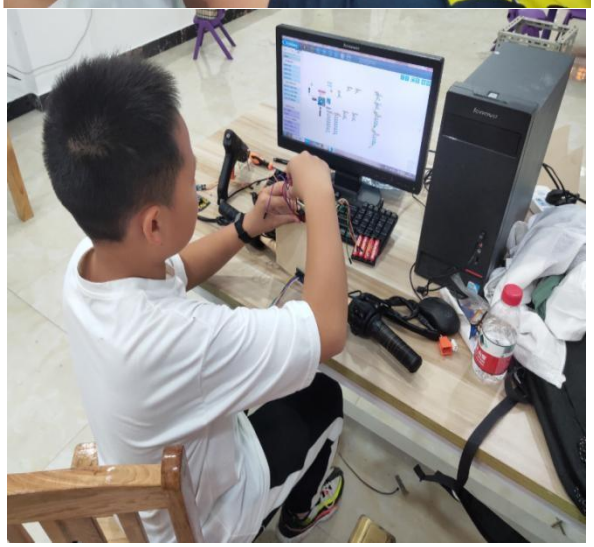


Figure 4 Exterior Installation

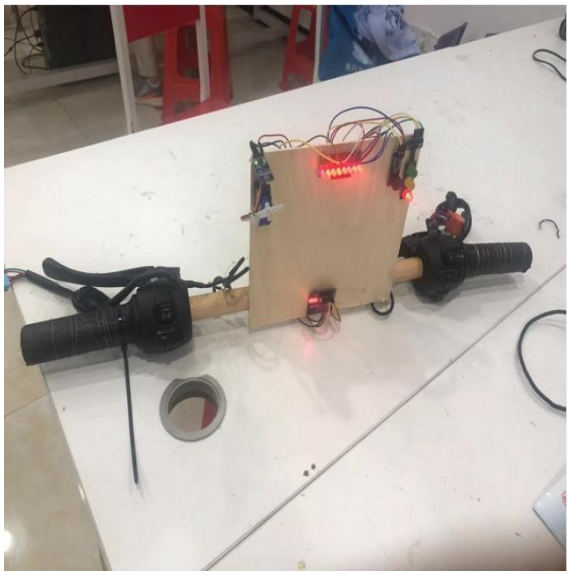


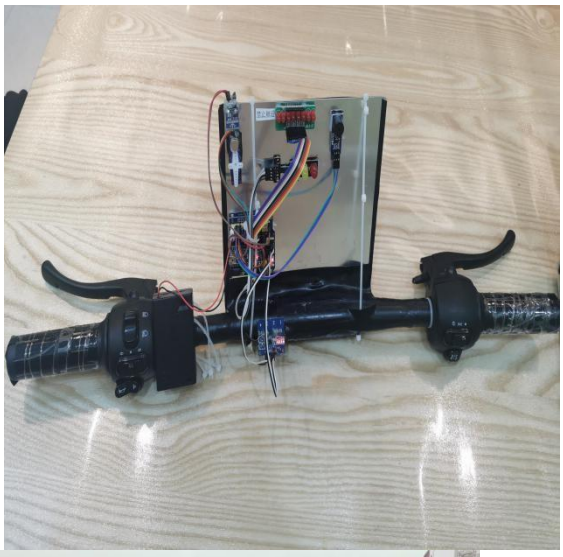
Figure 5 The first generation of works is completed

Figure 6 The author is full of joy

（2）Second Generation Work: Considering that the wooden products are not strong enough and durable enough, we purchased aluminum alloy steel plate and aluminum alloy handlebar on the internet, and re-improved the production.

Figure 1 Buy aluminum handlebar and steel plate online

Figure II Reassembly



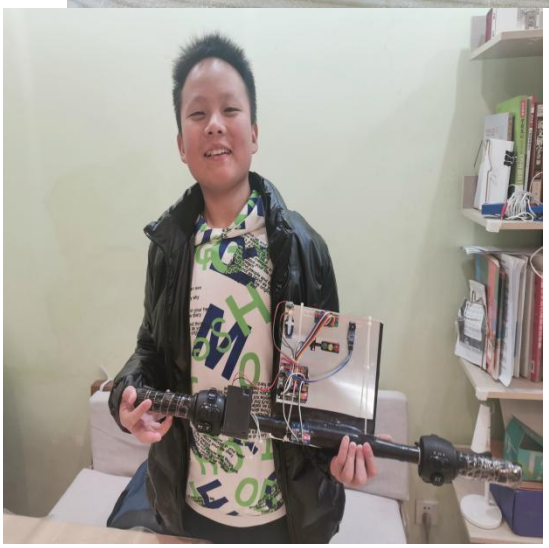


Figure 3 The second generation of aluminum alloy works

Figure 4 The author experienced the fun of remodeling

（3）The third generation of works: taking into account the product if the product is maliciously destroyed, such as interference with magnets and other artifacts will affect the intelligent judgment of the product leading to misjudgment, thus reducing the efficacy of the product, so online customization to buy acrylic plate box, which can effectively prevent the product from being maliciously interfered with.

3.2. Static Brake Inspection System

3.1.1 Project idea

The vibration motor device is installed on the brake skin, while the homemade vibration sensor probe is installed on the horse reward, and the touch chip is utilized to extend a copper wire wrapped around the handlebar of the electric car so as to achieve the purpose of multi-point detection. When the driver gets on the car and then holds the handlebar, a voice announcement will be made to remind the driver to press the button on the handlebar to start brake detection, thus further ensuring user safety.

The driver can activate the detection system by pressing the brake handle. When the brake is applied, the vibration motor sends out vibrations and the vibration data is received by the vibration sensor of the secondary spring detection module located on the outer side of the brake skin, which is designed to increase the amplitude of vibration of the vibration motor to make the detection effect more effective.

If the brake pads are less worn then the brake pads engage the hub more strongly, so that the vibration efficiency will be weakened due to full engagement of the hub, by writing a program, we will convert the values detected by the vibration sensors into intuitive data, start to detect the vibration sensor vibration values detected by the vibration sensors if the vibration value is greater than 1,000 will be executed on the program+ 1, if the value is not too large, the vibration motor vibration value is weakened more, proving that the brake pads are less worn, thus proving that the brake performance is weakened more. In other words, if the vibration value is not greater than 1000, the more the vibration value of the vibration motor is weakened, it proves that the brake pads engage the hub more strongly, thus proving that the brake pads are less worn out, and eventually the percentage of brake performance will be displayed in a visual form for the driver's reference.

If the brake skin failure, the driver pressed the button after pinching the brake handle, because the brake skin away from the hub, the vibration frequency issued by the hub is weakened less, so that the vibration sensor detected vibration value will be greater than 1000 on the screen shown above the number of gradual increase in the final braking performance into a percentage of the form of the display, then the rider can be immediately found that the vehicle brake Defective bear two can quickly replace the vehicle to stop, thereby reducing the incidence of bicycle brake failure traffic accidents. When the output power of the motor driver is reduced, the vibration motor is running at a low speed, which can reduce the vibration frequency of the motor and increase its vibration amplitude, thus enhancing the penetration ability.

According to the analog quantity when the vibration sensor detects, we have judged through the program, when the analog quantity is greater than 1000 when the set variable will be+ 1, thus we can know that when the vibration motor is pressed tightly and the vibration efficiency of the vibration motor is larger, the variable change amplitude is small at this time, on the contrary, when the vibration motor is not pressed tightly, the value of the variable change amplitude is larger at this time.

When the program starts, it starts counting down for 15 seconds, and at the same time, the vibration motor

emits vibrations and the vibration sensor

Detects the vibration value and calculates the collected vibration value analog within 15 seconds by setting the The variable sets the analog value of the vibration sensor. If the variable is greater than 1000 analogs, then +1 is processed and the analog value measured during the set time is processed to produce the exact data and then subtracted from 100, which produces the correct final value.

This means that the less the brake pads are worn, the more the brake pads engage the hub, the more the vibration efficiency of the vibration motor is weakened by fully engaging the hub, and the more the vibration value is weakened, the more the brake pads are engaging the hub, thus proving that the brake pads are less worn.

3.1.2 Specific implementation process

3.1.2.1 Prepared Materials

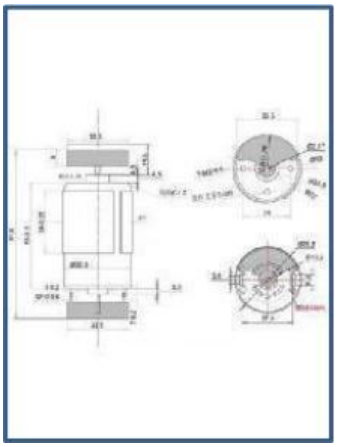


Fig. 5 Internal schematic of the vibration motor

The modules shown below are: ESP32 domestic chip, LCD display, drum brake, voice announcement module, electric bicycle brake handle, vibration motor, electric bicycle handlebar, aluminum alloy metal plate

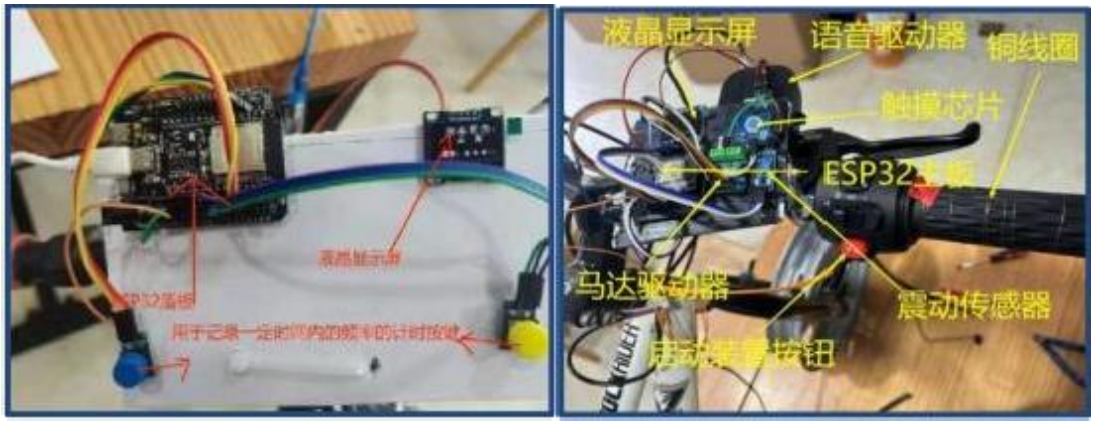
3.1.2.2 Gathering information and producing functional analyses

Fig. 24 (Initial device rendering)

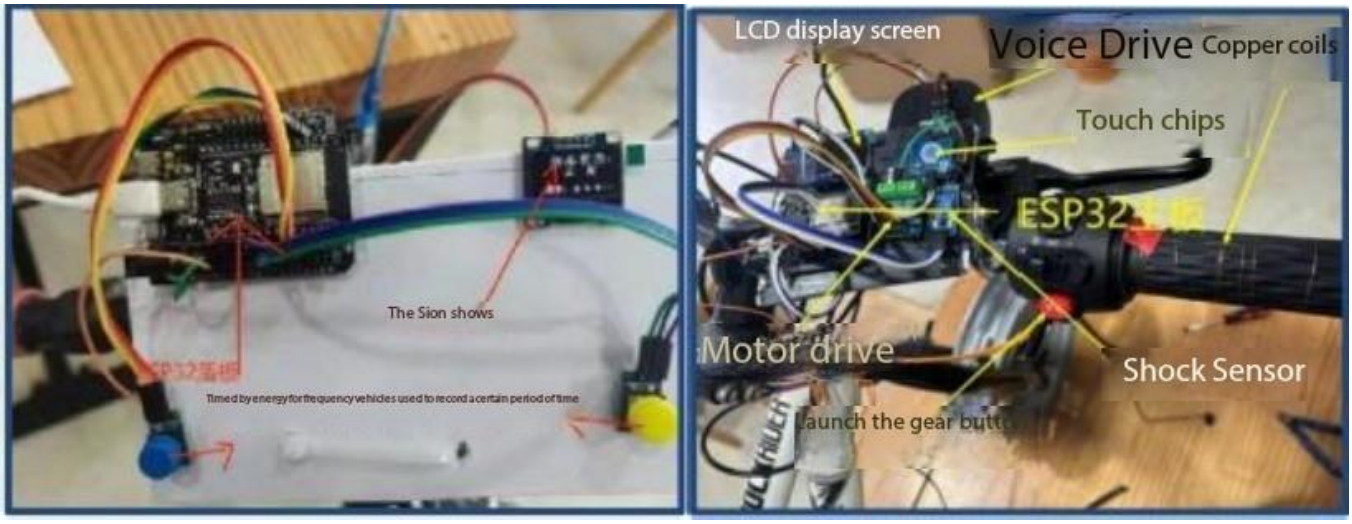
Figure 25 (Final installation design)

We utilize an advanced normally open type vibration sensor to combine the probe part of the vibration sensor and the vibration motor into one, thus forming an integrated sensor. When the driver gets on the bike and puts his hand on the handlebar, the copper wire on the handlebar transmits the current to the touch chip, which generates an inductive current and automatically drives the speech.

The audio driver makes a voice announcement from the speaker, reminding the driver to activate the detection device by pressing the button and pinching the brake. The vibration sensor detects the vibration value when the vibration motor starts to vibrate, and if the brake pad fits the wheel well, then the vibration efficiency of the vibration motor will be weakened by the brake pot, which will result in the vibration value detected by the vibration sensor to be smaller, and we can analyze the vibration value by the LCD display located on the handlebar. We can analyze the vibration value detected by the vibration sensor, if the value is smaller then it can also prove that the wear of the brake pads is smaller, and finally the data will be converted into a percentage form to be displayed on the handlebar LCD screen located on the handlebar of the bicycle, so that the driver will know the brake status before driving.



3.1.2.3 Many studies and improvements



Notes: The following data I have visualized in the form of a line graph by converting the analog of the tested serial port.

First experiment: As shown in the figure, an ultrasonic probe is utilized to emit frequencies and record the frequency emitted versus the pressure

The law between forces, but after practical experiments, it was concluded that the acoustic frequency of the ultrasonic probe used was not able to penetrate the metal material, so much so that this option was also ruled out.

Test data and analysis : Fig. 28: Writing the program, Fig. 29: Building the ultrasonic probe and performing the reception test; Fig. 30 Placing the ultrasonic probe on the bicycle for testing, Fig. 31 Placing the ultrasonic probe on the brake pads for testing.

Figure 28

Figure 29

Figure 30

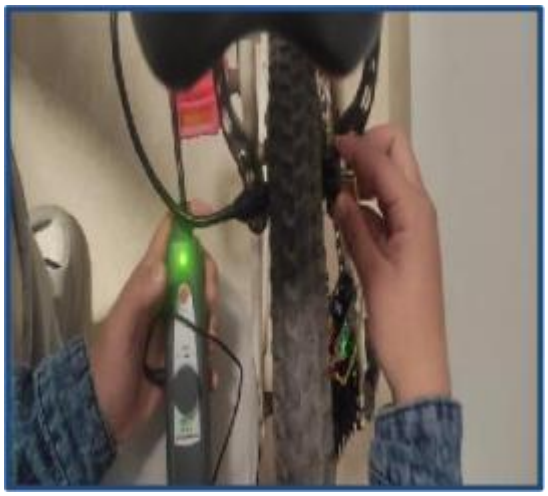


Figure 31

Figure 32

Notes: Since the sound waves at the time of the test conducted were not able to penetrate the brake skins and thus conduct to the other side, to the extent that this party

The case did not measure analog data.

Test data and analysis

The detection tool is a leak instrument, when the internal pressure is greater than the external pressure due to the internal and external pressure difference is greater once the container has a leak, the gas will be flushed out of the leak when the leak size is small and the Reynolds number of higher flushed out the gas, the formation of turbulence, turbulence in the vicinity of the leak will produce a certain frequency of acoustic vibration frequency and the size of the leak, when the leak is very small and the acoustic frequency of the sound wave is very high when the human ear can not be heard, but they can spread in the air, known as airborne ultrasound. Airborne propagation, known as airborne ultrasound, ultrasound is a high-frequency short-wave signal, its intensity with the propagation distance, the increase and the rapid attenuation of ultrasound waves have directionality. I installed an ultrasonic probe on the other side of the brake skin and set the frequency within the voltage range that this motherboard can withstand. As shown in Figure 31, the detector light is not lit red on behalf of the other side of the ultrasonic probe issued by the frequency did not reach the detector, thus proving that at this time in the range of the motherboard voltage to withstand the frequency of ultrasonic probes, can not penetrate the brake skin, and thus can not detect the brake skin for the degree of engagement of the wheel hub. The theoretical basis of this program: the smaller the frequency of ultrasonic waves penetrate the stronger and involves the Doppler law, if the brake skin wear is better, the better the degree of adhesion to the tire, then one side of the ultrasonic probe will be due to the sound wave frequency of the brake skin of the degree of meshing is good, then the sound wave will be hindered by the more serious. But after I use the ultrasonic probe need 50V voltage to control to reach 28kHz ultrasonic frequency output, (20kHz or more is ultrasonic, ultrasonic frequency is lower then the better the penetration) may be able to penetrate the brake skin and in the test process will be adjusted to the voltage of 32 volts motherboard can not withstand the high voltage caused by burned to the point that the program is ruled out. Infrasound frequency low penetration, after wikipedia information found that can penetrate the wheel material, but does not meet the relevant provisions. Wheel material (aluminum alloy density 2.63g/cm3) brake skin (resin-based density 1.2g/cm3)

Second experiment

Since the load cell needs to change the appearance of the brake base, the load cell needs to be installed on the inner layer of the brake skin in order to detect the degree of wear of the brake skin in relation to the pressure. On the other hand, since the load cell is affected by how hard the driver squeezes the brakes, it is not possible to detect the performance of the brakes. This led to the elimination of this option.

Fig. 33 Detection program being written; Fig. 34 Sensor for brake detection; Fig. 35 Detection module subsection Fabric; Fig. 36 Assembling the detection device.

Figure 33

Figure 34

Figure 35

Figure 36

Test data and analysis

Figure 37 (with brake pad failure or high wear)

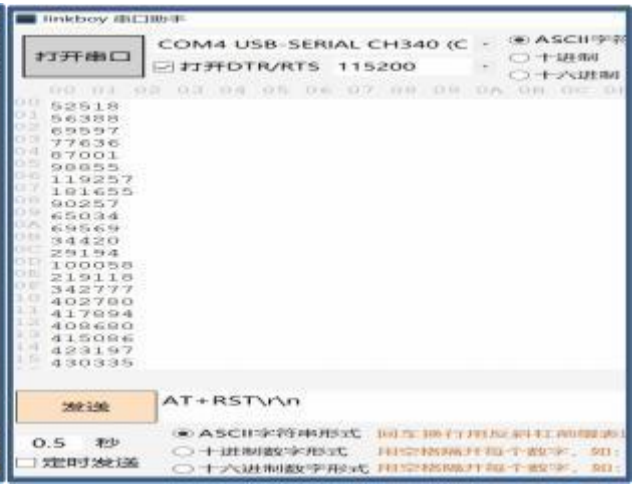


Figure 38 (when brake pads are normal)

Table 1

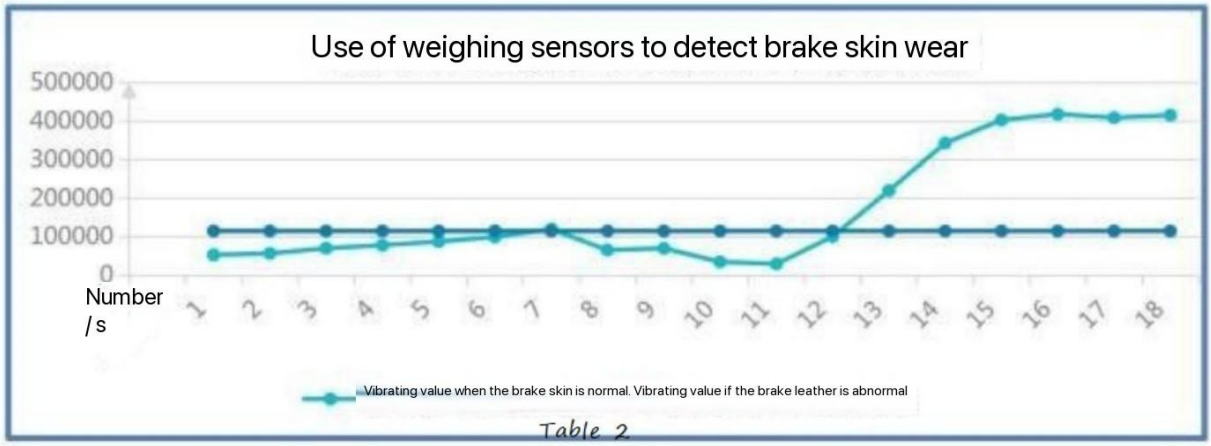


Table 2

Frequency / s	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
The vibration value of the brake skin when normal	52518	56388	69597	77636	87001	98855	119257	65034	69569	34400	29194	100058	219118	342777	402780	417894	408680	415086
Vibration values when the brake skin is abnormal	114501	114485	114514	114493	114513	114507	114507	114521	114498	114546	114519	114534	114528	114520	114539	114520	114565	114545

Data analysis

The analog value of the load cell located on the inside of the brake skin is displayed in the form of an ASCLL string using serial communication. It is also displayed in the form of a line graph chart. (Graph created with the WPS tool) As shown in Fig. 37, the brake pads are more worn, so they do not fit well to the wheel hub, so the elastic deformation of the load cell is smaller, and the variation of the measured values is smaller. On the contrary, as shown in Fig. 38, when the brake pads are normal, the values are high.

However, the disadvantages of the solution are 1: the load cell must deform the aluminum bar, so it must be inserted on the inside of the brake skin resulting in a change in the safety structure of the brakes 2: as can be seen from the line graph, the amount of change in the value detected by the load cell is more unstable. Therefore, this solution is excluded.

The third test used flexible piezoelectric sensors and vibration motors for detection

Since the load cell can not detect the brake status detection accurately. So we changed the detection method

The piezoelectric transducer is based on the principle that the higher the pressure, the higher the amplitude and the lower the frequency, and the lower the pressure, the lower the amplitude and the higher the frequency. So the use of advanced flexible piezoelectric sensor principle (when the piezoelectric film is subject to external forces, will produce mechanical displacement, thus generating a very small high-voltage alternating current of about ± 90V), the piezoelectric sheet placed in the production of the shell, through the other side of the vibration conducted to the piezoelectric sheet, and then the vibration of the data back to the computer for arithmetic to derive the frequency of the brakes when the brakes are normal, in the use of A pair of worn brake pads for testing, the frequency value and then compare the two, found that the test out of the data is not accurate, because it is necessary to make the piezoelectric sheet continues to produce deformation in order to produce the voltage of the high and low variations of the program is also ruled out.

Figure 39

Figure 40

Test data and analysis ：

Fig. 41 (When brake pads are normal)

Fig. 42 (When brake pads are abnormal or worn out) Table 3

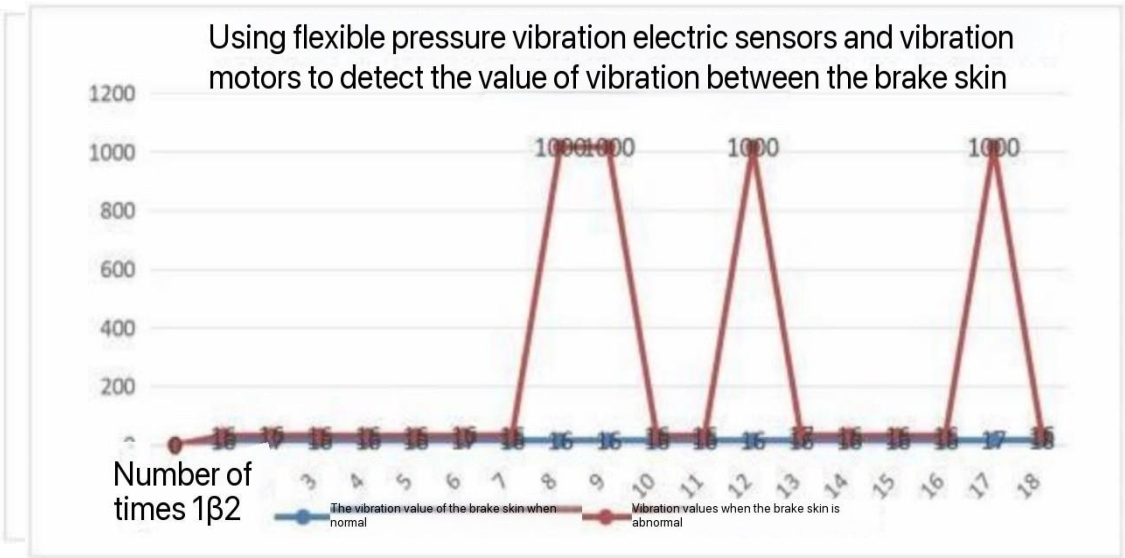


Table 4

	Number / s	1	2	3 Graphi	4	5	6	7	8	9	plu:	11	A billion yuan index	B Drag	14	lett	16	17	18
The brakes are Hongzheng. Shake when it's thick. numerical value		16	17		16	Exten	17	Exten	16	turr	estir	turi			16	turr	estir	17	18
The brake skin is different Always move. numerical value		16	16	16	16	16	16	16	1000	1000	16	16	1000	17	16	16	16	1000	16

Fig. 39: Resulting diagram after assembly; Fig. 40 Diagram of the structural parts of the third test; Fig. 41: Simulated quantities of the brake pads when they are normal; Fig. 42 Simulated quantities of the brake pads when they are abnormal or worn out; The simulated quantities of the tests are converted into line graphs to visualize the results, as shown in Tables 3 and 4. （When the brake detection device is activated, the vibration motor starts to vibrate and the piezoelectric sheet of the flexible piezoelectric sensor located on the opposite side starts to receive the vibration value.

As shown in Tables 3 and 4, the characteristics of the piezoelectric pads and the distance between the vibration motor and the pads, which resulted in low and insignificant values, made it impossible to accurately detect the degree of wear on the brake skins, so that this solution was ruled out.

The fourth test: brake performance testing based on the principle of SW18010P and vibration motor

The principle of the spring-loaded vibration switch sensor (normally open type vibration sensor) and the vibration motor is utilized. By attaching the vibration motor to the brake wall and the vibration sensor and probe to the outside of the brake skin, the driver can activate the detection device by pressing the button and pinching the brake handle after riding on the vehicle, and by installing the vibration motor and the vibration sensor on the brake wall, the vibration motor sends out the vibration frequency when braking is initiated and the vibration sensor on the outside of the brake skin receives the vibration value. When the brakes are applied, the vibration motor sends out a vibration frequency, and the vibration sensor on the outside of the brake skin receives the vibration value. Since the brake skin is less worn, the brake skin engages the hub to a better extent, so that the vibration efficiency of the vibration motor is weakened due to the full engagement of the hub, by writing a program, we will convert the value detected by the vibration sensor into intuitive data. The value is greater than 1000 will be+ 1, if the brake skin state is intact, that is, the vibration value is not greater than 1000, the vibration value is weakened the more, proving that the brake skin to engage the hub of the strength of the larger, thus proving that the brake skin wear is small, finally I through the program I have achieved success, and in the form of intuitive braking performance of the percentage of the brake performance for the reference of the driver.

Fig. 43: Programming of this test in progress; Fig. 44 Commissioning of the mounting device in progress; Fig. 45 Hardware commissioning; Fig. 46 (final test performed); Fig. 47: Analog values when the brake pads are normal; Fig. 48: Analog values when the brake pads are not functioning.

Test data and analysis:

Figure 43 (Program being written for the project)

Figure 44 (Commissioning of the installation unit in progress)

Figure 45 (data being tested)

Figure 46 (final testing performed)

Fig. 47 (when brake pads are normal)

Figure 48 (when brake pads are not functioning)

As shown in Table 5 I have converted the vibration values into the form of a line graph and it can be seen that when the brake skin wear is small

The efficiency of the vibration emitted by the vibration motors is reduced by the fact that the brake skins are better adhered to the hubs of the wheels.

The more the metal hub is weakened, the smaller the value detected by the vibration sensor, so we only need to check the size of the vibration value to know how much the brake pads are worn.

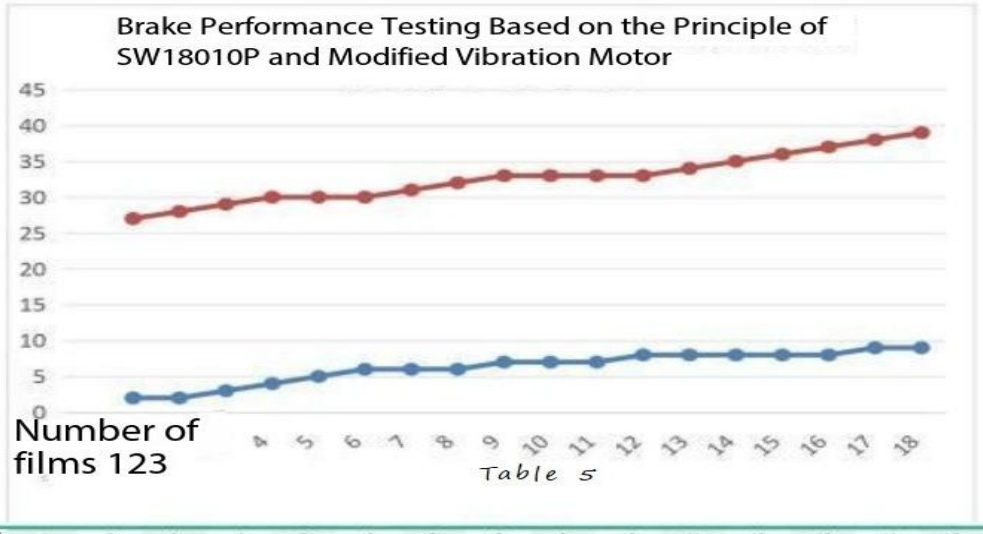


Table 5

	Number/s	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
23	The brake skin is right																		
24	Sometimes it vibrates. numerical value	2	2	3	4	5	6	6	6	7	7	7	8	8	8	8	8	9	9
	The brake skin is different																		
25	Frequent vibration numerical value	27	28	29	30	30	30	31	32	33	33	33	33	34	35	36	37	38	39

Table 6

I loosened the brake line to simulate an abnormal state of the brakes, and I can see that the efficiency of the vibration from the vibration motor is not weakened much by the metal hub when the brake pads are worn out, because the brake pads are poorly fitted to the hub and the vibration efficiency is not weakened much by the metal hub, so that when the value of the vibration is greater than 1,000 (analog), it will be+ 1, and if the brake pads are intact, i.e. the value of the vibration is not greater than 1,000, the more the vibration is weakened. The more the vibration value is weakened, the stronger the brake pad engages the hub, resulting in a larger value detected by the vibration sensor, thus proving that the brake pad is less worn.

The project results of the fourth test were demonstrated:

Fig. 49 Mounting of the detection section; Fig. 50 Placement of the main board as well as the display section; Fig. 51 Full appearance of the unit.

Figure 49

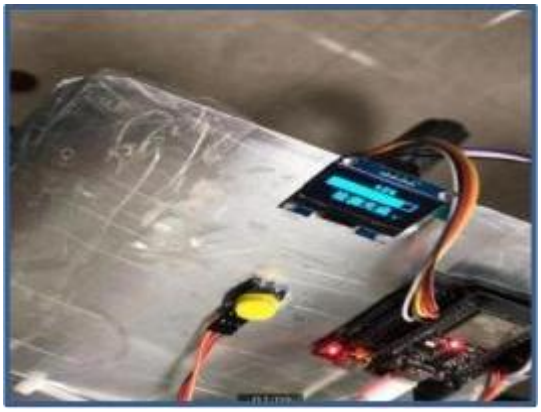


Figure 50

Figure 51

3.1.2.4 Three improvements and refinements to the device

First device improvement: integrated processing of the detection device Note:

(The principle and method of the fourth test is the final solution of the project to detect the degree of wear of the brake skin) The spring switch vibration sensor and the vibration motor are placed on a metal strip, when the driver grasps the brake, if the brake skin is worn out when, at the same time, the engaging force will become larger, the wheel will consume the vibration of the vibration motor's vibration efficiency will be the more, so the vibration sensor's detection value will become smaller, because the two modules into one so the device size will become smaller, eventually reach just stick the module on the outside of the bicycle, so that the driver can ride before the static detection through the LCD screen. Two modules into one so the device volume will become smaller, and ultimately reach only need to paste the module bicycle in the outer side of the brake skin, so that the driver before riding can be static detection of the way in the LCD screen to learn the degree of wear of the brake skin.

Fig. 52 Long, bendable metal universal tube;

Fig. 53: Design of the improved detection section;

Fig. 54 being disassembled.Solving the vibration sensor;

Fig. 55 Motor and sensor ensemble;

Fig. 56 Integrated detection module for this system improvement.

Figure 52

Figure 53

Figure 54

Figure 55

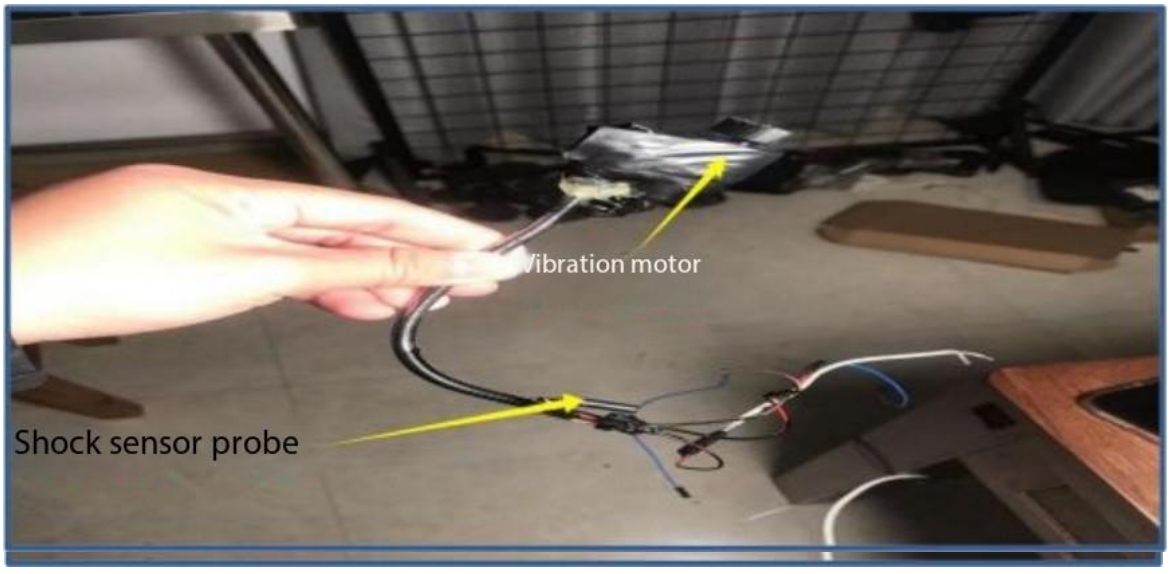


Figure 56

This system, which can detect the wear state of the brake pads in advance before riding the bicycle, is translated into the form of percentage on the LCD display of the handlebar of the bicycle for the driver's reference to achieve the purpose of further safe riding.

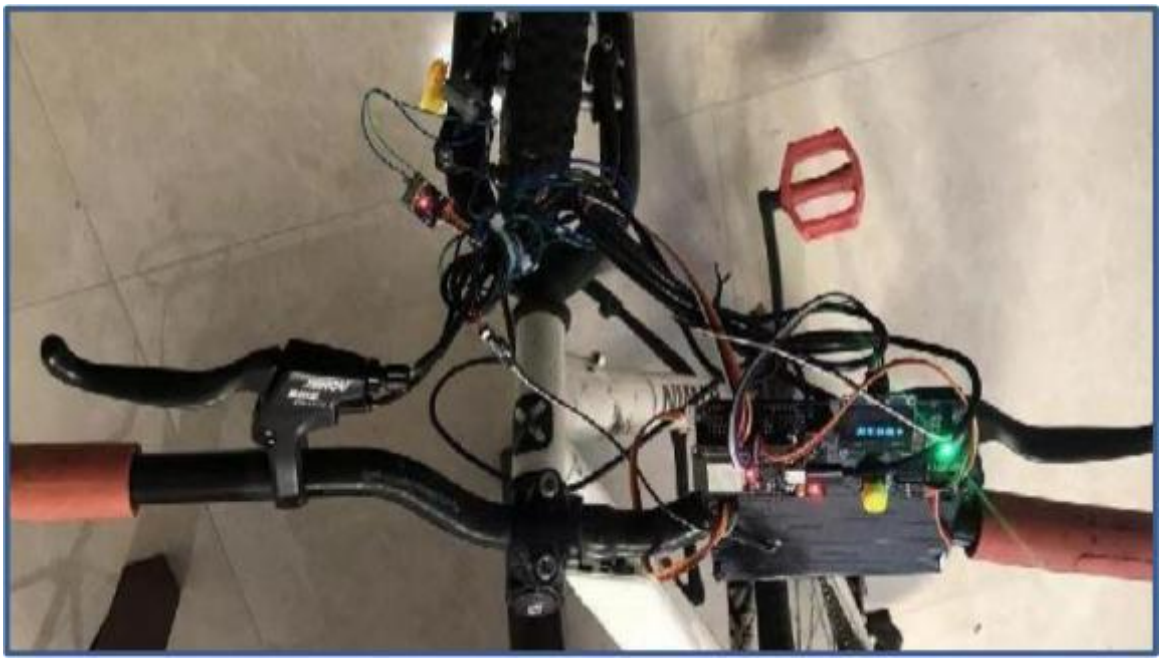


Figure 57 (First Improvement Results Presentation)

The first improvement relative to the first-generation unit developed in the fourth test: the main board LCD buttons as well as the

Vibration sensor and vibration probe for integration. Separate the probe of the vibration sensor from the receiving part. And place the probe and vibration motor on the same universal metal tube, on the basis of the results of the fourth test period, to further improve the practicality of the system, as well as the safety and reliability, to ensure that the detection effect can be achieved at the same time streamline the integration process, so that the device becomes more product-oriented and practical. The results of the first improvement are shown in Fig. 57.

Second device improvement: the addition of voice notification alerts

In the second generation of the device, a voice playback function is added, i.e. when the driver is seated on the bicycle, a voice reminder will be issued to remind the driver to press the button to pinch down the brake handle, and when the final brake skin wear is detected to be large, a voice broadcast will also be issued to say, "The vehicle is worn out, it is recommended that another vehicle be driven," thus confirming the performance status of the brakes to further enhance the safety. This will confirm the performance status of brand further improve the safety performance.

FIG. 58 Voice driver, and wiring circuit diagram; FIG. 59 Speaker diagram; FIG. 60 Improved results diagram

Figure 58

Figure 59

The voice broadcast module using matrix drive, is to control the specified pin high and low levels, so as to drive the speaker to send voice broadcast, for example, when pin 1 is high, then the voice module will not be like the speaker to send pulse signals, only when the low level of the voice reading module pin 1 will send out electrical signals, so as to drive the speaker to send out the command audio.

Author's production design: power on can stimulate the voice announcement function, remind the driver to start the brake detection device to detect the degree of brake skin wear.

Figure 60

Figure 61

Figure 62

Third device improvement: a secondary spring vibration conduction detection module

At present, with the development of the times, many electric cars and bicycles use drum brakes to a greater extent. Since the drum brake has a closed driver can not use the naked eye to observe the wear condition of the brake skin and the brake line is intact, so the development of upgrading to the drum brake can be applied to the brake static detection device is practical.

I separated the probe of the vibration sensor and placed a piece of the vibration motor underneath the probe and placed the

Placement on a long piece of stainless steel metal for the purpose of integrating the detection module and attaching the device to the drum brake wall for the purpose of streamlining.

Figure 63

Figure 64

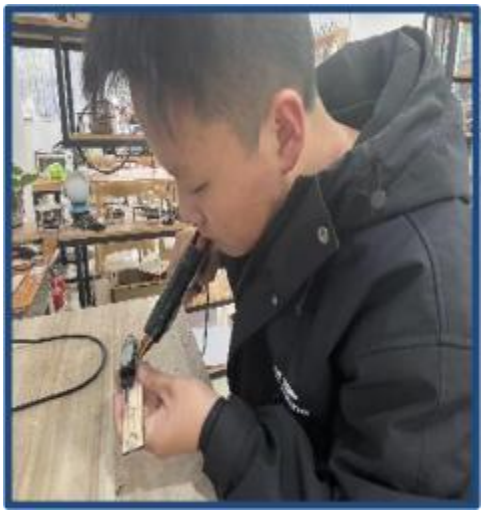


Figure 65

Figure 66

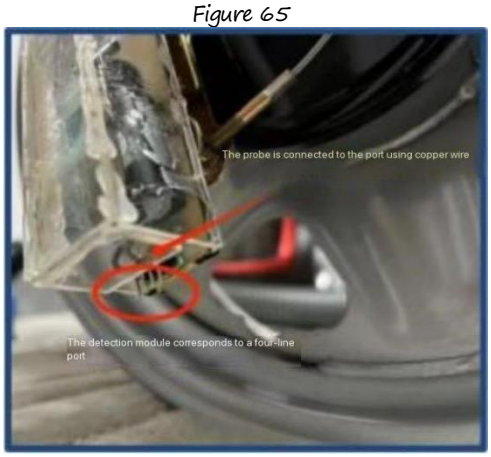


Figure 6 7

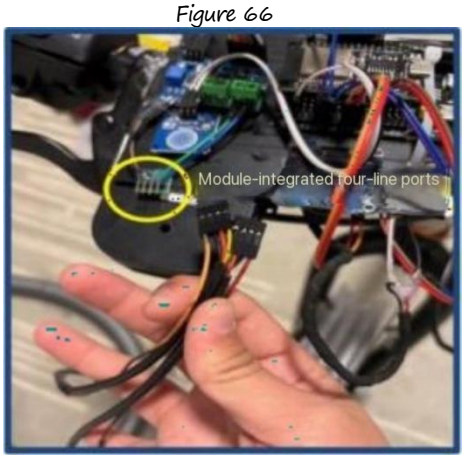


Figure 6 8

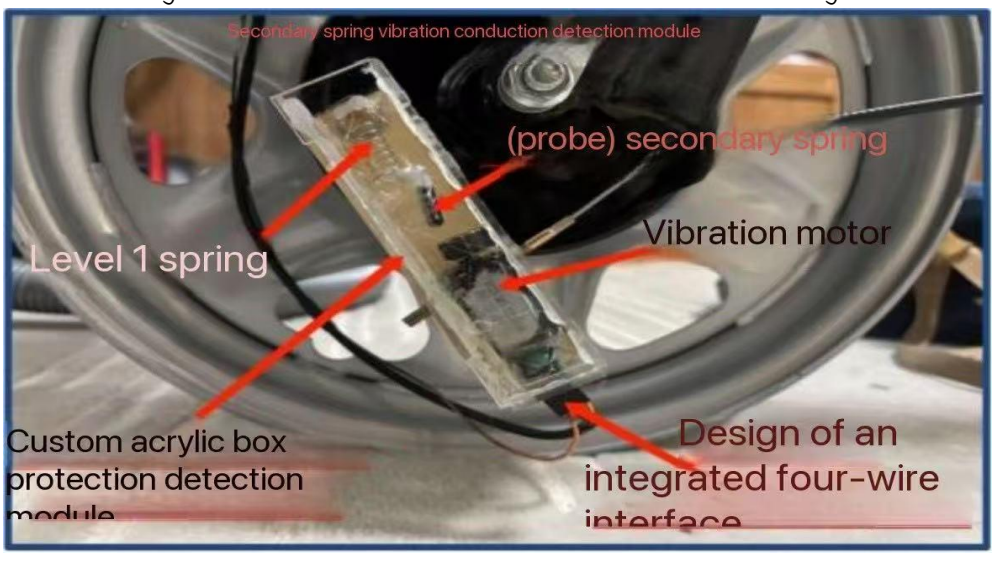


Figure 6 9

Figure 63 shows the vibration probe being disassembled, Figure 64 shows the vibration probe and the vibration motor being wired, Figure 65 shows the transmission of the vibrations.

The final result of the device is shown in Fig. 69, where the sensor probe is merged with the primary spring and the vibration motor is combined into one, and in Fig. 68, where the final result of the device is shown. Fig. 67 shows the integration port of the corresponding detection module for the handlebar, and Fig. 72 shows the specific placement of the improved detection module "Secondary Spring Vibration Conduction Detection Module" for this project.

The biggest innovation of this system improvement is to place the vibration probe of the detection module at the end of a spring, so that the amplitude generated by the vibration motor vibration can be further improved to make the detection effect more accurate and better, and another is the improvement of the system, which is mainly the integration of the previous generation, the independent small button used to activate the detection device is set in the inner handlebar of the electric car and the detection device into an integrated module design, the circuit board combines the two wires of the motor and the two wires of the probe to develop a four-wire port socket. The detection device is made into an integrated module design, the circuit board combines the two wires of the motor and the two wires of the probe into one to develop a four-wire port socket, and then connects a four-wire long wire to the integrated port on the handlebar, which is also integrated into the handlebar, and combines the two wires of the motor driver, the vibration sensor, and the two wires of the connected probe into a four-wire port. four-wire port, ultimately making the device more productized as well as practical.

IV. Market analysis

4.1 Market context and demand

With the popularization of e-bikes, their safety is a growing concern. According to relevant statistics, a high percentage of e-bike accidents are caused by one-handed handlebar control and brake failure. In order to enhance cycling safety, the market demand for safety monitoring systems for e-bikes has increased significantly, especially for one-handed handle bar protection systems and static brake monitoring systems. These systems can effectively prevent safety accidents caused by one-handed riding or brake failure through intelligent technical means.

4.2 Market Status and Competitive Landscape

4.2.1 market size

The market size of electric bicycle safety monitoring system is growing rapidly. With the implementation of the new national standard, the safety performance requirements of e-bikes have been further improved, promoting the market penetration of related technologies. It is expected that in the next few years, with the popularization of intelligent functions, the market size will maintain a compound annual growth rate of more than 10%.

4.2.2 competitive landscape

Currently, the major players in the market include traditional e-bike manufacturers, smart hardware providers, and tech startups. For instance, brands such as Yadi and Taito have taken the lead in introducing intelligent safety monitoring systems in some of their high-end models. In addition, a number of technology companies have entered this market by providing modularized solutions, which is driving the rapid iteration of the technology.

4.3 Policy environment and market opportunities

4.3.1 Policy support

The government's attention to the safety of electric bicycles has been increasing, and the new national standard puts forward higher requirements for the safety performance of vehicles, such as limiting the weight share of plastic parts and increasing the dynamic monitoring function. These policies provide strong support for the development of safety monitoring systems.

4.3.2 market opportunity

Consumption upgrading: With the increase of consumers' demand for safety and intelligence of e-bikes, the market potential of high-end and intelligent products is huge.

Sharing Economy: The popularity of shared e-bikes provides a broad market space for safety monitoring systems. For example, through intelligent monitoring systems, operating companies can monitor the status of vehicles in real time and reduce operational risks.

Technology upgrade: With the continuous progress of battery technology, sensor technology and big data analysis, the performance and reliability of the safety monitoring system will be further improved.

4.4 Challenges and response strategies

4.4.1 The technical challenge

Detection accuracy: The existing technology still needs to be improved in terms of detection accuracy and anti-interference ability, for example, photoelectric sensors are susceptible to the problem of blockage.

Cost control: The higher cost of ITS may affect its popularity in the low and middle market.

4.4.2 response strategy

Technological innovation: Improve detection accuracy and reliability through multi-sensor fusion and intelligent algorithm optimization.

Platform development: adopting modularized design to reduce R&D and production costs while enhancing the maintainability of the system. Policy guidance: actively participate in the development of industry standards and promote the standardization of technology.

4.5 future outlook

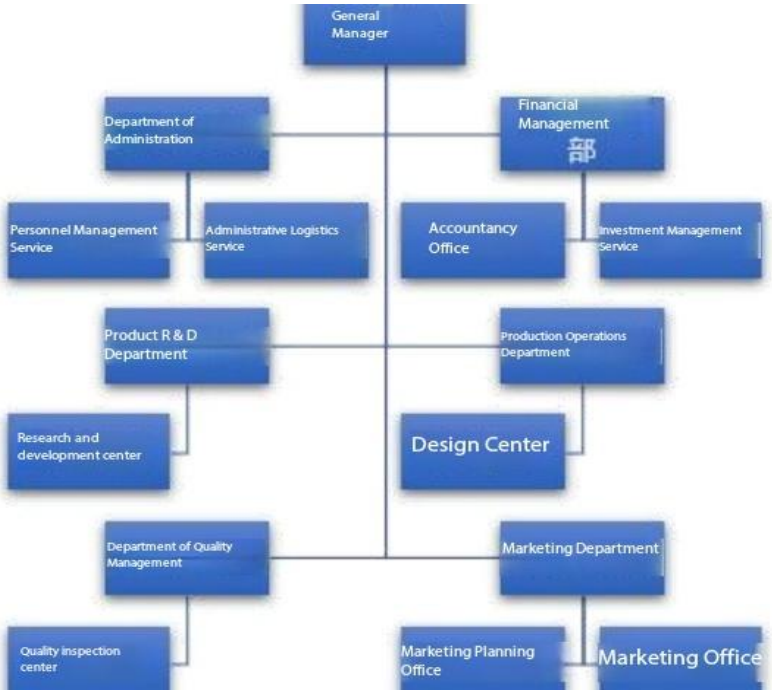
E-bike one-handed control handle and static brake monitoring system has a broad market prospect. With the continuous progress of technology and policy support, intelligent and integrated safety monitoring system will become the standard equipment for e-bikes. In the future, through technological innovation and market expansion, relevant enterprises are expected to make greater breakthroughs in this field, providing stronger protection for the safe travel of e-bikes.

V. Project management system

The project consists of an administration department, a financial management department, a product development department, a production and operation department, a quality management department and a marketing department. Field Marketing Department. The project adheres to the tenet of "to establish business with precision, to win with quality", and adheres to the business philosophy of promise and trustworthiness. In the process of project management, the enterprise personnel actively learn advanced management concepts, strengthen the quality management system and the construction of certification, focus on product innovation and research and development, and rational arrangement of departmental responsibilities in order to achieve the maximization of organizational goals.

5.1 Project organization chart

The principle of the project organizational structure design. Under the guidance of this principle, the project is mainly divided into administration, financial management, product development, production and operation, quality management and marketing department and other six departments, each department according to the functional needs of different positions. In the early stage of the project, the general manager of the simpler departmental organizational structure is responsible for the overall operation of the project, the department managers in the division of responsibility based on close contact, and jointly promote the development and progress of the project.



5.1.1 Functional responsibilities of each department

General Manager:

Main tasks:

1, the overall grasp of the project development direction, preside over the project's day-to-day business management, organization and implementation of the project's annual business plan and investment program.

2、Responsible for convening and presiding over the project general manager's office meeting, coordinating, checking and supervising the work of various departments

3、Responsible for project culture construction, help shape the project image.

4. Coordinate the relationship between various departments and strengthen the communication between upper and lower levels. Administration Department:

Main tasks:

1、Assist the general manager to complete the management of the project.

2. Organize and arrange project office meetings, or prepare for other project meetings and related important activities in conjunction with the relevant departments, keep records of meetings and collate minutes of meetings, and issue documents in accordance with the decisions of the meetings as required.

3. The Personnel Management Division is responsible for specific personnel work such as project recruitment, staff training and performance appraisal.

4、Responsible for the project's general affairs, good logistics.

5、Responsible for the management of project office facilities.

6, to assist the information sector to do a good job in the overall development of information systems to improve administrative office efficiency.

7, seriously grasp the water, electricity measurement of basic management.

8, responsible for the procurement of various items, to ensure that the completion of all procurement tasks on time. Financial Management Department:

Main tasks:

1、Responsible for project fund raising, use and distribution, to ensure the normal flow of project funds.

2, the preparation of the project monthly and annual financial statements, financial accounts, annual financial reports.

3、Responsible for the accounting work of the project, cooperate with the corresponding business director, finance and taxation departments to carry out annual audit work, timely and accurate declaration and payment of various taxes.

4, the development of the project's quarterly financial plan, determine the budget program, and monitor and check the budget of each department.

5、Processing the daily reporting work of various departments, and do the year-end accounts. Product Development Department:

Main tasks:

1、Responsible for technical research and technological innovation, and technology to give rationalization proposals.

2、According to the market analysis report, determine the direction of project research and development, and determine the core technology and products of the project.

3、Improve production methods, improve production efficiency and reduce production costs.

4. Close contact with research institutes to keep abreast of the latest science and technology.

5、Actively research and develop related series of products. Production Operation Department:

Main tasks:

1、Do a good job of project product packaging design.

2, with the R & D department, do a good job of updating and improving the production process.

3. Ensure the high efficiency of product production and guarantee the adequate supply of project products to meet the market demand.

4. Guaranteeing the orderly management of production and avoiding production safety accidents.

5, do a good job in the procurement of equipment, try to reduce production costs, to provide quality products at low prices.

6, test the safety of related product technology, improve the quality assessment system to ensure product quality. Marketing Department:

Main tasks:

1、Close to the nature of the project, close contact with the market customers.

2, do a good job of market research and analysis, develop project marketing plan, determine the market development strategy.

3、Responsible for the project image publicity, public relations work requirements: a strong market sensitivity and market analysis ability; with strong public relations and publicity ability and interpersonal relationship skills.

Quality Management Department: Main tasks:

1, the organization of the project's internal quality management system planning, implementation, supervision and review.

2, responsible for the organization and coordination of product certification.

3, in accordance with the technical documents to prepare inspection standards and inspection specifications; organization and implementation of raw materials, purchased parts, self-made parts of the inspection, as well as the product process, finished product inspection, and issue test reports.

4, the organization of the project within the review of nonconforming products, for quality problems organizations to develop corrective, preventive and improvement measures, and tracking verification.

5、Responsible for the integrated management of quality records, regular quality analysis and assessment.

6、Responsible for the quality inspection of the whole project products.

7, responsible for inspection and measurement and test equipment control, to ensure product quality to meet the specified requirements.

8、Participate in the review of the supply side, participate in the analysis and processing of user feedback.

5.1.2 Number of key members of each department at the time of creation

name (of a thing)	Number of personnel	note
deputy director	1	not have
Department of Administration	4	Administration Manager 1 1 Personnel Supervisor 2 logisticians
Department of Financial Management	3	1 Finance Manager 1 Head of Investment

		Accounting Supervisor 1
Product Development Department	4	1 R&D Manager 3 office technicians
Production Operation Department	7	Production department manager 1 person, Staff 6
Marketing Department	5	Marketing department manager 1 person 2 Sales Officers 2 staff members
Quality Management Department	5	1 Manager, Quality Control Department Quality inspectors 2

5.2development project

The e-bike one-handed handle bar and static brake monitoring project aims to solve the hidden safety problems of e-bikes caused by one-handed riding and brake failure through intelligent technical means. The project will be promoted in three phases: pre, mid and post, to ensure the maturity of the technology, market acceptance, and ultimately industrialized application, to enhance the safety and intelligent level of e-bikes.

5.2.1 Prior development goals

5.2.1.1 Requirements Research and Analysis

Objective: To gain an in-depth understanding of the market and user needs, and to provide a basis for product development.

Task: Organize the team to conduct questionnaire surveys and interviews with e-bike users, focusing on the status quo and user pain points of one-handed riding and brake failure. Analyze the limitations of the existing technology and define the technical direction of the project in light of the requirements of the new national standard. Communicate with e-bike manufacturers, shared mobility platforms and relevant regulatory authorities to understand the policy direction and market demand.

5.2.1.2 Technology development and validation

Goal: Develop a prototype system with one-handed grip monitoring and static brake monitoring.

Task: Set up a technical R&D team to carry out research on multi-sensor fusion technology, including pressure sensors, photoelectric sensors and capacitive sensors. Design and build a laboratory test platform to test and optimize the performance of the sensors to ensure detection accuracy and anti-interference capability. Develop intelligent algorithms to realize real-time monitoring and early warning functions for one-handed grip behavior and brake performance. Complete the development of the system prototype, and conduct preliminary testing and verification in the laboratory environment.

5.2.1.3 Project planning and management

Objective: To develop a detailed project plan and ensure that the project moves forward in an orderly manner.

Tasks: Develop a project timeline with clear tasks and timelines for each phase. Establish a project management team responsible for the overall coordination and progress tracking of the project. Determine the project budget, including R&D expenses, test equipment procurement, personnel costs, etc. Establish cooperative relationship with suppliers to ensure the supply of raw materials and components.

5.2.1.4 Initial testing and optimization

Goal: Identify and resolve technical issues and optimize system performance through lab testing.

Tasks: simulate different riding scenarios in the laboratory environment to test the system's functionality and performance. Collect test data, analyze the performance of the system under different conditions, and optimize the sensor layout and algorithm. For the problems found, make technical improvements to ensure the reliability of the system.

5.2.2 medium-term goal

5.2.2.1. product optimization and refinement

Goal: Optimize the prototype system into a mature product that is ready for marketing.

Task: Optimize the system according to the laboratory test results to improve the detection accuracy and stability. Develop user-friendly interactive interfaces, such as vehicle display or mobile APP, to facilitate users to view monitoring data and warning information in real time. Conduct small batch trial production to ensure product quality and consistency.

5.2.2.2 Field testing and user feedback

Goal: Collect user feedback through field testing to further optimize the product.

Task: Work with e-bike manufacturers to install monitoring systems on selected vehicles for field testing. Put a small number of test vehicles on the shared mobility platform to collect user feedback and usage data. Analyze user feedback and optimize the product for user needs and actual use scenarios.

5.2.2.3 Marketing and Cooperation

Objective: To establish marketing channels and build cooperative relationships with relevant enterprises.

Task: Develop marketing strategies including branding, product demonstration and user education. Establish cooperative relationships with e-bike manufacturers, shared mobility platforms, distributors, etc. to promote the market application of the product. Participate in industry exhibitions and technical seminars to demonstrate product advantages and enhance brand awareness.

5.2.2.4 Standard setting and certification

Objective: To promote technical standardization and seek participation in the formulation of industry standards.

Task: Participate in the formulation of industry standards and incorporate the technical specifications of the monitoring system into the standard system. Apply for relevant technology patents to protect intellectual property rights. Complete product certification to ensure compliance with national and industry standards.

5.2.3 later target

5.2.3.1 Product Promotion and Market Development

Goal: Achieve large-scale market application of the product and increase market share.

Mission: Increase marketing efforts to expand the application of our products to e-bike manufacturers and shared mobility platforms. Develop the international market, cooperate with overseas e-bike manufacturers and distributors, and promote product exports. Based on market feedback, continuously optimize product features and services to enhance user experience.

5.2.3.2 Data collection and analysis

Goal: Optimize product performance through big data analysis to support urban traffic management.

Task: Establish a data collection platform to collect real-time operational data of the monitoring system. Analyze the data to mine user behavior patterns and accident risk points to provide a basis for product optimization. Cooperate with urban traffic management departments to share data and provide support for urban traffic planning and safety management.

5.2.3.3 Technology development and upgrading

Goal: Continuously invest in R&D to maintain technological leadership.

Mission: Track industry technology dynamics and carry out research and development of next-generation technologies, such as the integration and application of artificial intelligence, Internet of Things and other technologies. Cooperate with universities and research institutions to carry out joint projects between industry, academia and research to promote technological innovation. Regularly release upgraded versions of products to improve the level of product intelligence and user experience.

5.2.3.4 Branding and user education

Goal: Enhance brand influence and user safety awareness.

Task: Strengthen brand building and enhance brand awareness and reputation through advertising and public welfare activities. Carry out user education activities, popularize the knowledge of electric bicycle safety and the role of monitoring system to users through a combination of online and offline. Establish a user feedback mechanism to respond to user needs in a timely manner and improve user satisfaction.

5.3 Student Team

Team members	personal experience	a specific division of labor
Wu Zhiyuan (1946-), PRC politician an overall plan delimit	The 36th National Youth Science Festival Technology Innovation Competition Online Networking Event Global Invention 2023-2024 Congress (China) Second Prize First Prize of the 37th Guangdong Youth Science and Technology Innovation Competition and the 39th Guangdong Youth Science and Technology Innovation Competition Third Prize, Finalist of the 40th Guangdong Youth Science and Technology Innovation Competition Gold Medal at the Macau International Innovation and Invention Fair 2024 Macao International Innovation and Invention Fair 2024 Hong Kong, Guangdong and Macao Grand Bay Area Awards 2024 Guangdong Children and Youth Invention Award Second Prize Second Prize of the 33rd National Youth Science and Technology Innovation Contest Second Prize of the 33rd Guangdong Youth Science and Technology Innovation Competition	Students will be selected in January 2022 by Zhiyuan Wu. The topic, study the knowledge related to electric bicycles, reviewed domestic and international literature. And group members organized a technical seminar, found the existing prevention of single-handed control handlebar riding device can not well meet the needs of users, embedded development, circuit design part.
SIN YING YIN product technology chief technology officer		Ms. Sin Ying-Yan is in charge of the design of the product body and the technical department. Points.
Suzhou and Yang Cheng (1938-), PRC politician, prime minister 1987-1998 product stability	The 18th Song Ching Ling Children and Youth Invention Award ''Silver Award'' Third Prize of the 38th Guangdong Youth Science and Technology Innovation Competition Shenzhen Youth Science and Technology Innovation Competition (2022 First Prize) (2020 First Prize) (2023 Second Prize) (2021 third prize) 2021 Shenzhen Youth Science and Technology Games First Prize	Mr. Su Yangcheng was responsible for testing the adaptability and stability of the project device on the e-bike.

qualitative testing	2024 Shenzhen Outstanding Communist Youth League member

	Shenzhen SAR Model Teenager 2023 Most Beautiful Pengcheng 名 2021 Bao'an District Education System Excellent

5.4 Team of Experts

5.3 Specialist advisers

Expert consultants member	trump card (in card games) key role	concrete introduction
Wayne Chen (1949-), Chinese US film director	labor Program technical guidance	Associate Professor, Ph.D. Supervisor, Department of Electrical Engineering and Applied Electronics, Tsinghua University, China Presided over 5 Natural Science Funds, 1 Sino-German International Cooperation Fund, and 973 sub-projects of National Defense. 2 projects, 1 863 sub-project, and 2 sub-projects of key R&D programs. He has published 3 monographs, 187 papers, 49 SCI papers, and more than 1,000 citations. Times; Winner of the First Prize of the Fourth Chinese University Press Book Award, and the Most Influential Paper in Thirty Years of Control Theory and Applications. Winner of the 2019-2020 IEEE Transactions on Energy Conversion Best Paper Award, Winner of the IEEE PES Electric Machinery Committee (EMC) Prize Paper Award

Tina Lam	Guidance on academic thinking	Professor, School of Instrumentation Science and Electrical Engineering, Jilin University, Ph. Jilin University ''Tang Aoqing scholars'' excellence A post professor, long-term engaged in the development and application of geophysical based on the major needs of the country, for the construction of Sichuan and Tibet high-altitude hazardous areas, mine production and other major engineering water source of hidden dangers survey problems, has presided over the national key research and development program project (with a total funding of 40 million yuan), National Natural Science Foundation of China Key Fund, United More than 20 scientific research projects at provincial and ministerial levels, such as the key projects of the United Fund for Science and the Outstanding Young Scientist Fund, etc. More than 70 papers have been published in high-influence journals of geophysics and mainstream journals of instrumentation, such as IEEETPE, IEEE TGRS, etc., and 49 patents have been authorized for the invention. (1st), including 4 US patents (1st). He was awarded the First Prize of Jilin Provincial Scientific and Technological Progress by the first co-completor, and the First Prize of China Coal Association by the second co-completor.
Hu Yafeng (1936-), second governor of Hainan	Financial Literacy Guide	PhD Candidate. Academic Achievements: financial development, cash holding level and its market value Journal of Central University of Finance and Economics (CSSCI, No. 9, 2018) 2)Relaxation of short selling constraints, cash holding and its market value Financial Theory and Practice (CSSCI, No. 1, 2019) 3)Executive compensation gap, cash holding and its market value Business Economics and Management (CSSCI. (CSSCI, No. 9, 2021) 4) Governance effects of institutional investors: a cash holding value perspective Business Research Research (CSSCI, No. 6, 2022) (5) Cross-listing, cash holdings and their market value Statistics and Decision-Making (CSSCI, No. 11, 2022)

VI. Project effectiveness

6.1 social value

6.1.1 Enhancing Public Transportation Safety

E-bikes have become an important tool for short-distance travel in cities due to their convenience, but traffic accidents caused by one-handed riding and brake failure are frequent, which bring hidden dangers to the safety of public transportation. Through the one-handed control handle and static brake monitoring system, it can effectively prevent accidents caused by one-handed riding or brake failure, reduce casualties and property losses, and improve the overall safety of urban transportation.

6.1.2 Promoting the modernization of urban governance

With the acceleration of urbanization, the safety management of electric bicycles has become an important part of urban governance. The application of the monitoring system can not only improve the safety of individual riding, but also provide a decision-making basis for urban traffic planning and road facility optimization through data collection and analysis, and promote the scientification and refinement of urban governance.

6.1.3 Promoting industry standardization and upgrading

The new national standard puts forward higher requirements on the safety performance of electric bicycles, and the development and application of the monitoring system is in line with the policy guidance, which can promote the technological upgrading of the industry and facilitate the development of the electric bicycle industry in the direction of intellectualization and standardization. This not only helps to improve product quality, but also enhances consumer trust in e-bikes and promotes the sustainable development of the industry.

6.1.4 Reducing social costs

The occurrence of traffic accidents not only brings losses to individuals, but also increases the burden of society in many aspects, such as medical care and insurance. Reducing the occurrence of accidents through monitoring systems can effectively reduce social costs and improve the efficiency of social resources.

6.2 Educational dimension

6.2.1 Enhancement of safety awareness

The promotion of one-handed handlebar control and static brake monitoring system is not only an advancement in technology, but also a reinforcement of cyclists' safety awareness. By reminding cyclists of standardized operation through technical means, it can subconsciously enhance their safety awareness and reduce accidents caused by bad habits.

6.2.2 Precision Safety Education

The monitoring system can be combined with a safety education platform to provide personalized safety education content for different groups (e.g., the elderly, youth, takeaway riders, etc.). For example, if data analysis reveals that takeaway riders frequently ride one-handed because they are in a hurry, safety training can be targeted to enhance their safety awareness.

6.2.3 Promoting universal access to safety education

The system can be used as an auxiliary tool for safety education, allowing riders to intuitively feel the importance of safe driving through feedback in actual operation. For example, when the system detects one-handed riding, it automatically reduces the speed and sends out an alarm, which can effectively remind riders to correct their behavior, thus promoting the transformation of safety education from theory to practice.

6.2.4 Helping to educate school safety

In the campus environment, electric bicycles are a common means of transportation for students and staff. By promoting the monitoring system in schools, it can provide vivid examples for campus safety education and help students to establish proper traffic safety concepts and develop good riding habits from an early age.

6.2.5 Cultivation of innovative entrepreneurship

Innovative thinking stimulation: The program encourages students and technicians to develop new technologies, stimulating their innovative thinking and entrepreneurial spirit.

Opportunities for entrepreneurial practice: The project provides a platform and opportunities for the people concerned to start their own business, so that they can learn and grow in practice, and develop their entrepreneurial ability and practical experience.

appendice

1.Technology Patent

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王永文(0755-26406581)

发文日：

2024 年 08 月 12 日

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根据专利法第 28 条及其实施细则第 43 条、第 44 条的规定，申请人提出的专利申请已由国家知识产权局受理。现将确定的申请号、申请日等信息通知如下：

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申请人：武志远,武广源
发明人：武志远,陈余,武广源
发明创造名称：一种电动自行车静态刹车检测系统
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专 利 权 人：武志远

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第 1 页(共 1 页)