fortunately, food waste has continuously been rising, and this scheme does not claim to reduce food waste significantly. Still, hopefully, it can be used to remind the public that it is necessary to start taking action to reduce food waste.

This scheme can also be optimized. For example, it can also be widely used in industrial activities, social security, elderly services, etc. It is believed that after the popularization of the intelligent refrigerator assistant in the future, the food waste caused by improper storage methods can be significantly reduced, food safety can be guaranteed for the user, and the goal of improving life intelligence can be achieved.

Food waste has become a significant problem in the development of the world. We believe the proposal can greatly reduce this situation, and the world will improve with the cooperation of human beings and machines.

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Brief introduction of school and instructors

Pui Ching Middle School, Macao is a school that combines the traditional rigorous academic attitude with the spirit of free and open inquiry. Pui Ching is dedicated to innovations in education and the holistic development of students. Through constantly improving our school facilities and devoting resources to teacher development, the school aims to help students develop intellectually, mentally, physically, emotionally, and socially.

Jianyuan LIN: Teacher at Pui Ching Middle School, Macau. He has been working in software engineering for more than ten years. He enjoys the value and significance of making progress together with his classmates.

Executive Summary

06 A Rotor Fault Detection System Based on Nonlinear and Dynamic Response Models

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Highlights

This research proposes a comprehensive solution for accurately detecting rotor faults and enhancing the overall quality of motor production. By utilizing electromagnetic induction and acoustic signal processing, this system offers a reliable and efficient solution for fault detection, which is crucial for ensuring safe and reliable motor operation in various industrial settings.

Challenges: The aim is to enhance the operation of factory inspection lines to prevent catastrophic motor failures, thereby ensuring user safety and improve efficiency.

Solution: A comprehensive inspection system was developed based on electromagnetic induction, which is capable of accurately diagnosing rotor faults and quality in motors/generators in both production and maintenance environments.

Outcome: The system could diagnose motor rotor faults with near 100% detection rate after workmanship modifications. The FM1388 core and the EEMD algorithm aided in analysis, effectively reducing noise or interferences, and providing a high-fidelity extracted vibration signal.

How does the proposed system detect rotor faults in motors?

The system works by utilizing a magnetic testing platform to observe the magnetic physical vibration phenomenon of the rotor. The rotor is excited by a time-varying magnetic field, which generates an electromagnetic response associated with rotor failure or quality issues. The response is then converted into an acoustic signal processing for fault detection. The acoustic signals of rotor vibration are sampled and processed by a DSP chip, and the background noises are removed. The original vibration signals from the electromagnetic probe are extracted. By analyzing the amplitude of spectrum data, the degree of the faultiness of the inter-turn short circuit of the rotor is further derived by referencing. The system employs a comprehensive detection system based on electromagnetic induction to minimize noise interference in production and maintenance environments, which ensures accurate fault diagnosis and analysis.

How does the neural network models trained and applied?

The system utilizes a DSP chip to sample and process the acoustic signals of rotor vibration, which effectively eliminates high-frequency noise interference while retaining more fault details. Additionally, the system employs a comprehensive detection system based on electromagnetic induction to minimize noise interference in production and maintenance environments, which ensures accurate fault diagnosis and analysis.

Can this technology be applied to other industries besides household refrigeration?

The system can be utilized in various industrial applications, including machinery manufacturing, power generation, and transportation. It can be used for Motor Production Inspection (Large-Sized Rotors for Power Generation), electric vehicles, and power generation. The system offers a reliable and efficient solution for fault detection, which is crucial for ensuring safe and reliable motor operation in various industrial settings.

Executive Summary

Abstract

This research proposes a detection system that utilizes electromagnetic induction to accurately diagnose rotor faults in motor and quality while minimizing noise interference in production and maintenance environments. The system is designed to improve the efficiency of factory inspection lines and prevent catastrophic motor failure accidents, thereby ensuring personal safety. The system employs a time-varying magnetic field to excite the rotor under test, which generates an electromagnetic response associated with rotor failure or quality issues. The response is then converted into an acoustic signal processing for fault detection. This approach offers a comprehensive solution for accurately detecting rotor faults and enhancing the overall quality of motor production. Additionally, the system can be utilized in various industrial applications, including machinery manufacturing, power generation, and transportation. Overall, the proposed system offers a reliable and efficient solution for fault detection, which is crucial for ensuring safe and reliable motor operation in various industrial settings.

Keywords: Rotor Fault Diagnosis, EEMD (Ensemble Empirical Mode Decomposition), Noise Reduction.

1. Project Overview for Detecting Rotor Faults in Motor

Electric motors and generators are essential to modern-day life, and their safe operation is vital to the operators. Therefore, studies on the fault of the electric rotor, diagnosis accurately, and maintenance of all kinds of faults have high practical values, especially with the proliferation of electric vehicles and wind power. The winding rotor is the core component of the motor, and its short-circuit fault is one of the primary modes of failure that seriously affects the performance and safety of these electric machines. But, more importantly, the safety of the users is the biggest concern.

This research aims to develop a comprehensive detection system based on electromagnetic induction, which can accurately diagnose faults and the quality of motor/generator rotors in production and maintenance environments. In the process, based on the principle of the EEMD algorithm, a noise reduction chip is proposed to decompose the original vibration signals of the rotor. Furthermore, it is hoped that the signal segmentation can be reduced to the maximum extent by resolving the limitation of wavelet transformation(Gaeid & Ping, 2011).

2. Project Design of Detecting Rotor Faults System

Structure of this System

This project consists of as following part: motor rotor (type, size, power, and the number of turns are not restricted); electromagnetic probe (thin sheets of ferro magnetic material); electromagnetic generator (230VAC, to excite the inter-turn of the rotor windings); test control pillar stand (to hold the stationary controller in place); stationary controller (a hold that fits the electromagnetic probe); miniature stepper motor (for controlling electromagnetic probe to complete vertical detection); dual controller (to ensure the working stability of the stepper motor and reduce the delay of remote control launching); wireless remote control (a transmitting antenna can be fitted, for stepping motor to control the vertical operation of electromagnetic probe); sound level sensor (Bluetooth connection is available, function as data collection); virtual oscilloscope (i-Seekwhy, convenient data processing and waveform transmission); electrical control panel (which housed the test control pillar stand's wireless remote controller and stepper motor driver to controls the electromagnetic probe's movement to provide up, down, and stop movement); computer (Served as terminal output to process and display i-Seekwhy and sound level sensor); Noise reduction chip (Speech IC size: 7x7mm, demo board, recording board. Model: FM1388. Number of package outlines: TQFP-48pin. Integrated FortéMedia technology 2 stereo digital microphone ports).

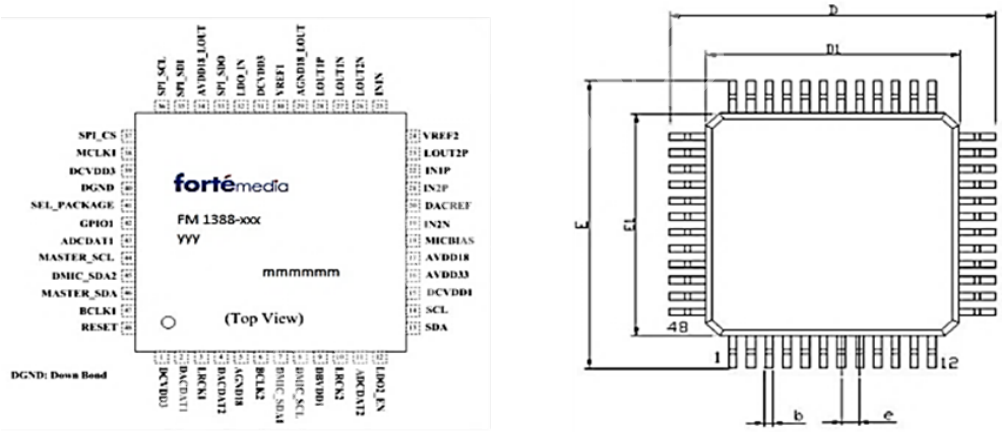

Figure 1 TQFP-48pin configuration

Research Methods of this System

The research experiment is divided into two stages: Stage 1- Automated Quality Inspection System for Rotor Coils of Commutator Motor; Stage 2 - Motor Rotor Fault Detection and its Signal Processing & Analysis Using EEMD.

By establishing a magnetic testing platform to observe the magnetic physical vibration phenomenon of the rotor, and further, with the help of sound sensors and virtual oscilloscopes, rotor fault signals can be collected and analyzed from the sound vibration spectrum.

The experiment steps are as follows:

(1) Assemble the electromagnetic generator and probe on the test control pillar stand with the manu-

al probe control mechanism.

(2) Install a small stepping electric unit at the connection of the handle of the test control pillar stand. A remote lifting control for the probe is used in place of the manual lifting handle. This improved the robustness of the device and allowed for more consistent measurement.

(3) Optimize the placement of the testing rotor between the grooves of the electromagnetic generator.

(4) Employ the use of remote control to decide the moving of the electromagnetic probe.

(5) We are utilizing a sound level sensor and oscilloscope i-Seekwhy to collect the rotor vibration spectrum data reflected by the electromagnetic probe.

7 steps of using the sound level sensor:

(1) Operate the control panel to start the detection system.

(2) Select the signal generator at the signal source.

(3) The signal generator has two sound channels. Select the sine wave.

(4) Open two soundtracks in the oscilloscope window.

(5) Display the two-sound track waveform and the synthesized waveform.

(6) Display the real-time frequency of the signal in the FFT window and frequency meter.

(7) Store data in the control panel.

By analyzing the amplitude of spectrum data, the degree of the faultiness of the inter-turn short circuit of the rotor is further derived by referencing(Fireteanu et al., 2014).

3. Experimental Results

The intuitive detection method involves a hierarchical rating system to judge the current quality of the rotor. The rotors are divided into six categories (A-F) based on the amplitude intensity of the electromagnetic probe. The categories range from "Breakdown" (requiring immediate replacement and repair) to "Off Size" (stable and not requiring any immediate attention). However, this method is noted to lack sufficient accuracy.

The automated method, on the other hand, uses a sound level sensor to collect the sound signal of the rotor vibration. The short-circuit condition of the rotor is then determined by analyzing this data. This method is reported to have higher accuracy and a greater degree of automation compared to the intuitive method. However, it is also noted that the sound level sensor can be affected by environmental noise, which may introduce errors in the detection results.

This part also discusses an improvement to the automated method using a sound level sensor and an oscilloscope to collect the rotor vibration spectrum. This method is said to have higher accuracy and automation. The experiment was divided into eight groups, with a total of 96 slots detected, 31 of which were short-circuited.

This part concludes by acknowledging the limitations of the intuitive detection methods and the need for more accurate methods. It also provides a table of data from a hundred experiments, detailing the amplitude of the electromagnetic probe across different experimental groups and slots of each rotor.

4. Conclusion and Future Plans

Through experimental design, continuous project evaluation, project data analysis, innovative iterative research summarizing engineering methods, and the analysis of the rotor short-circuit vibration signal amplitude, this project has achieved its primary goal of accurately determining the rotor fault severity. The research started with the detection of alternating electromagnetic fields. The experiment was repeated to refine the detection process, and the results obtained reached the expectation in the end. The collected data are conducive to further research.

The experimental method proposed in this project can effectively improve the IMF (Intrinsic Mode Function) variable component caused by the suppression of wavelet transform on signal segmentation. Based on the principle of the EEMD algorithm, a noise reduction chip is proposed to decompose the original vibration signals of the rotor. It is not limited by time and can reduce the delay limit of signal segmentation by wavelet transform to the maximum extent, and then the original vibration signal of the rotors can be obtained. By removing the delay, the geometric characteristics of the original vibration signal can be well preserved. It is more effective than the general wavelet domain filtering method.

In this study, a comprehensive detection system based on electromagnetic induction is developed to minimize noise interference in production and maintenance environments and thus accurately diagnose motor rotor faults and quality. This research can improve the operation of factory inspection lines, prevent catastrophic motor failure accidents, and ensure the personal safety of users, which has great significance and value.

The automatic rotor fault inspection device developed in this project can be used for Motor Production Inspection (Large-Sized Rotors for Power Generation). Large rotors, such as those used in electric vehicles and power generation, are expensive, and their failures can cause massive safety and cost issues. In addition, one of the world's large numbers of moto/generator rotor waste problems results in heavy metal pollution. This research provides a valuable and satisfactory response to the problem. Moreover, it is used to improve the production efficiency of the factory assembly line. Electric power tools have countless manufacturing, construction, and facility maintenance applications. Also, it can be used to repair motor loss and prevent mechanical metal contamination.

The future engineering goal of this project will focus on researching and developing a set of comprehensive quality inspection systems for electric vehicle starting commutators. It is known that this can be done from the current extension principle. By extracting and analyzing the original vibration signal of the rotor, we aim to maximize the application of functional modules of the noise reduction chip. Optimize the storage layer of signal data and improve the standard connection for automatically managing changing data structures.

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Brief introduction of school and instructors

Lou Hau High School, Macao was founded by a labor union in the 1950s. The school adheres to the teaching reform for a long time and seeks progress in the reform. In recent years, the Teaching Reform Committee has been set up to carry out diversified intelligent evaluation, and constantly study and analyze the theoretical viewpoints, concepts and measures of education at home and abroad, so as to achieve the results of creative thinking teaching and quality education.

Yixing LIANG: Vice teaching director of The Macau Workers' Children High School since 2003 and he also serves as a member of the Secondary School Committee of the Chinese Physical Society, president of the Macau Physics and Education Research Society, president of the Macau Technicians Association, president of the Macau Youth Sailing Model Association, and vice president of the Greater Bay Area Innovation and Invention Association.

Executive Summary

07 A Detection System for Choosing Ripe Strawberry with Machine Learning

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Highlights

This project aims to improve the efficiency and accuracy of fruit classification, resulting in better quality control and a reduction in food waste. By utilizing computer vision analysis and machine learning algorithms, this project can aid in the timely harvesting, processing, and distribution of strawberries, ultimately benefiting the agricultural industry and consumers alike.

Challenges: The food industry has been challenged by "low detection efficiency" and "food adulteration" in recent years. This study uses strawberries to focus on improving detection speed and accuracy through computer vision and machine learning, facilitating fruit farmers during harvest and broadening machine learning applications in the food sector.

Solution: Experienced fruit farmers sorted harvested strawberries into four ripeness categories, with 150 images captured for each. We utilized Support Vector Machine (SVM) for classification and compared the results with those from a Convolutional Neural Network (CNN).

Outcome: A set of strawberry imaging equipment was developed. An advanced strawberry ripeness detection model was created.

What machine learning algorithms are used in this project?

This project utilizes two machine learning algorithms: traditional machine learning and deep learning. The traditional machine learning model used is SVM, which achieved an accuracy of 97.50%. The deep learning model used the method of transfer learning of convolutional neural network (CNN), and the classification accuracy of the final model is 94.28%.

How does this project benefit the agricultural industry and consumers?

This project benefits the agricultural industry and consumers by improving the efficiency and accuracy of fruit classification, resulting in better quality control and a reduction in food waste. By utilizing computer vision analysis and machine learning algorithms, the project aids in the timely harvesting, processing, and distribution of strawberries. This ultimately benefits the agricultural industry by increasing productivity and reducing costs, while also benefiting consumers by providing them with fresher and safer fruits.

Can this detection system be applied to other types of fruits?

While this project focuses on enhancing the detection and accuracy rate of strawberries, the methodology and techniques used in this project can be applied to other types of fruits as well. The project employs machine learning algorithms and computer vision analysis to prompt recognition of the ripeness stages of strawberries. The project analyzes images of strawberries and uses mathematical models to categorize the fruit into their respective ripeness stages. Therefore, with appropriate modifications, this detection system can be applied to other types of fruits as well.

Executive Summary

Abstract

The timely and accurate detection of fruit ripeness is critical in preserving food safety and maintaining market order. The project focuses on enhancing the detection and accuracy rate of strawberries: a popular fruit with a short shelf life and is highly perishable. The project employs machine learning algorithms and computer vision analysis to prompt recognition of the ripeness stages of strawberries. The project analyzes images of strawberries and uses mathematical models to categorize the fruit into their respective ripeness stages. Through the use of machine learning, the project aims to improve the efficiency and accuracy of fruit classification, resulting in better quality control and a reduction in food waste. Furthermore, by utilizing computer vision analysis and machine learning algorithms, the project can aid in the timely harvesting, processing, and distribution of strawberries, ultimately benefiting the agricultural industry and consumers alike. The project presents a promising solution for the future of the fruit industry and food safety.

Keywords: Strawberry Ripeness, Machine Learning, Support Vector Machine(SVM) model, Rapid Detection Method.

1. Overview of Choosing Ripe Strawberry Project

The document discusses a project focused on improving the detection and accuracy rate of strawberry maturity, a critical task in the fruit industry. The project uses machine learning and computer vision analysis to recognize strawberry maturity, expanding the application of machine learning in the food industry.

Strawberries are delicate fruits that are easy to spoil and challenging to store. Therefore, the timing of picking strawberries is crucial to avoid spoilage during transportation or delivering an unsatisfactory taste to customers due to early picking. The document highlights that the differentiation of strawberry maturity is an essential task in the fruit industry. The industry standard divides the ripening of strawberries into four stages according to the coloring area: green ripe stage (25%), white ripe stage (50%), color transformation stage (75%), and red ripe stage (full coloring).

The document discusses various research works on predicting the ripeness of different fruits. It mentions the use of color complete local binary patterns to extract image texture features and color histograms to extract image color features. It also discusses the use of shape and color of fruits for image feature identification and the use of algorithms like k-nearest neighbor classification and Sup-

port Vector Machine (SVM) for fruit species identification.

However, the document acknowledges that most fruit classification and recognition algorithms often use images in a strictly limited environment, eliminating the influence of the external environment on the pictures. But the actual environment is complex, and the color and texture characteristics of the fruit image become complicated along with the different growth cycles of the fruits. Therefore, better classification and recognition methods are needed to solve these problems.

The document proposes a simple, fast, and effective recognition strategy to classify strawberry maturity states using traditional machine learning and deep learning algorithms. This method provides a new direction for expanding the application of machine learning in the field of food.

2. Design and Implementation of Experiments

This part discusses the design and implementation of experiments aimed at improving the detection and accuracy rate of strawberry maturity using machine learning and deep learning. The experiment is divided into four parts: strawberry image acquisition, collection of original images of strawberries, feature extraction on the strawberry image sample, and maturity matching.

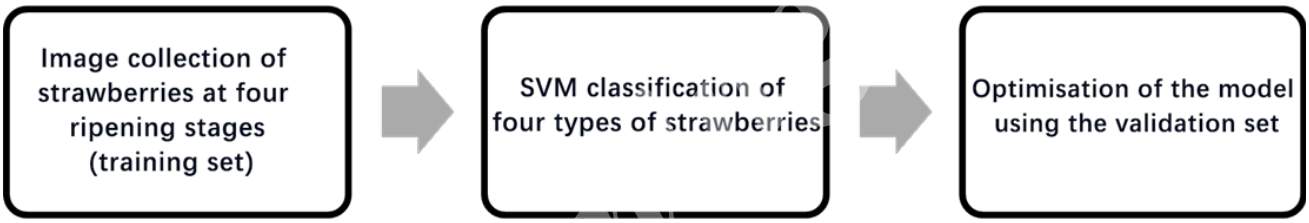

Figure 1 Experimental Procedure Design

The image acquisition process involves setting up a stable shooting environment with a portable LED light-supplementing studio, a mobile phone bracket, and a computer. The original images of strawberries are collected in four stages of ripeness: green ripe stage, white ripe stage, color transformation stage, and red ripe stage. A total of 600 images are saved in JPG format, with an image resolution set to 224*224.

This part then discusses the processing of strawberry digital images. The color in the strawberry image is quantitatively represented using an RGB color model. The background in the original strawberry image is segmented, and the mean value and standard deviation of the R, G, and B components of the strawberry image in the RGB color model are extracted.

This part also discusses the construction steps of the machine learning model. The data set of strawberries is divided by the method of Hold-out with the ratio of 8:2 into a training set (80%) and a test set (20%). The training set is used to generate the model, and the testing set is used to evaluate the model's correctness and error to verify the model's validity.

The results show that the rapid recognition of strawberry maturity recognition based on machine learning adopts two algorithm models: traditional machine learning and deep learning. The SVM

model results show that the model can accurately identify the maturity stage of strawberries with a few misjudgments.

There are still some technical difficulties to be solved in this project. However, it also highlights that the project provides a new solution for the automatic grading of fruits, reduces the burden of fruit growers, and promotes the excellent development of the fruit industry.

3. Conclusion and Future Plans

In this paper, a simple and rapid method of strawberry maturity recognition was proposed, i.e., a machine learning model was built to intelligently identify the ripeness of strawberries. First, a traditional machine learning model, SVM, is built with an accuracy of 97.50%. In the second part, a deep learning model is established, which adopts the method of transfer learning of convolutional neural network (CNN), and the classification accuracy of the final model is 94.28%. Both of the two models have achieved good performance at last, which proves the feasibility of this method. At the same time, it provides a new idea for further expanding the application of machine learning in automatic fruit classification.

The project aims at avoiding the loss caused by strawberry corrosion in the transportation process, reducing the risk to food safety and the cost and error of manual strawberry grading. A fast and accurate strawberry grading model is trained by building a model and training with a data set.

A computer vision system comprises an LED light-supplementing studio, an object stage, a fixed bracket, a mobile phone, and a computer. The experimental equipment is low in price and cost, convenient to use, simple in operation, and capable of collecting strawberry images well.

When constructing the traditional machine learning model, we conduct the digital processing for the strawberry image in the data set using the RGB color model and get the representation in R, G, and B components in the strawberry image. It is convenient for us to transform the RGB color model into the HSV model and Lab model to extract the color feature of the strawberry.

We needed to analyze the strawberry images when building the traditional machine model. We finally adopted the SVM model through online searches and various channels.

Next, we built a deep learning model and prepared to evaluate the accuracy of the deep learning model and compare it with the accuracy of the traditional machine learning model. The Convolutional Neural Networks (CNN) used in this work include the convolution, nonlinear, pooling, and up-sampling layers. Firstly, the RGB color model was used to segment the strawberry image in the data set. And then, we performed convolutional operations based on the convolutional kernel in the CNN (Convolutional Neural Networks) system to realize the extraction of the strawberry image characteristics. This method differed from the traditional machine learning method, which covered all the features of the strawberry image, not only the color features. The acquired strawberry images were preprocessed accordingly, and modified the image resolution modified to 224×224.

When dividing the data set, we discussed each other and expanded it to 11,340 pieces by image enhancement. The strawberry images were randomly divided into the training set, the test set, and the verification set according to the ratio of 6: 2: 2. Finally, the VGG16 network model was trained in advance on the ImageNet data set for testing.

The following is a schematic diagram of the confusion matrix of deep learning. The horizontal coordinate is the prediction category, and the vertical coordinate is the actual category. We randomly

select 594 pictures from each category to evaluate the model's accuracy. It is concluded that the total classification accuracy of this test set is 94.28%.

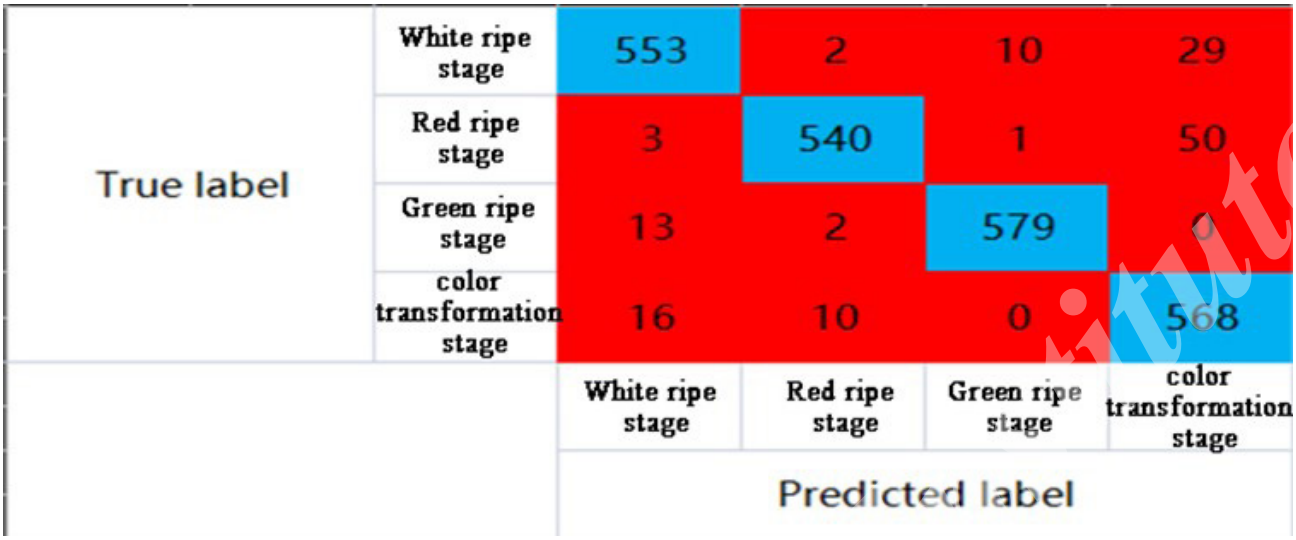

Figure 2 Schematic Diagram of Deep Learning Confusion Matrix

In the traditional machine learning model, SVM's classification effect is good, with an accuracy of 97.50%. In the deep learning model, we used the learning method of convolutional neural network migration, and the classification precision was 94.28%. In summary, the two models achieved good performance and provided a new idea to expand further the application of machine learning in fruit grading. This project not only adopted the method of building the traditional machine learning model but also tried to use different methods to solve the problem of strawberry grading by building a deep learning model, and the effect was excellent.

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Brief introduction of school and instructors

Jin'an Campus of Fuzhou No. 3 High School was opened in September 2019. It is a public junior high school in Fuzhou City with the same legal person and the same set of leadership. The school upholders the three school motto of 'encouragement, devotion to learning and practice', and forms the campus spirit rhyme of 'deep roots, far knowledge and practice in unity'.

Yuxia LIN: Graduated from Fuzhou University with a master's degree and is now a junior high school labor technology teacher. Guide students to participate in various scientific and technological innovation competitions and achieve certain results.

Siming HUANG: Graduated from Shaanxi Normal University and now works as a junior high school information technology teacher.

Executive Summary

08 Developing an Interactive Show-Wall with Smart Home Technology for STEM Learning

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Highlights

This project is a collaborative effort between students, teachers, and enterprises to introduce artificial intelligence elements into the decoration design of the lab. With this project, students can experiment with AI technology and create a sense of achievement and inspiration.

Challenges: Traditional IT labs are generally filled with various instruments but lack sufficient showcasing and exhibition aspects.

Solution: We integrated and presented computer vision and Internet of Things (IoT) technologies. With education as the foundation, we prioritized the use of open-source hardware and software, keeping scalability and affordability in mind.

Outcome: We developed an interactive AI smart wall that engages users in the Wenzhou dialect and includes intelligent home control terminals and sensors. This allows for facial-controlled lighting, posture-controlled curtains, voice-controlled air conditioning, and pattern-controlled lighting.

What is the purpose of the Interactive Show-Wall project?

This project utilizes two machine learning algorithms: traditional machine learning and deep learning. The traditional machine learning model used is SVM, which achieved an accuracy of 97.50%. The deep learning model used the method of transfer learning of convolutional neural network (CNN), and the classification accuracy of the final model is 94.28%.

How does the project incorporate smart home technology?

The Interactive Show-Wall project incorporates smart home technology by creating an AI interaction wall, which is a collection of intelligent home controllers with human-computer interaction. The data acquisition mainly includes cameras, microphones, lights, acceleration sensors, etc. The lab's home is whole-home smart, and an open-source smart home gateway, HASS, integrates intelligent lights of different brands.

What are the benefits of using an interactive show-wall for STEM learning?

The benefits of using an interactive show-wall for STEM learning are that it allows students to experiment with AI technology, creating a sense of achievement and inspiration for students who participated in the design. Additionally, the interactive show-wall with smart home technology reflects the people-oriented characteristics of AI and is closer to daily life.

Executive Summary

Abstract

This project is a STEM project jointly built by students, teachers, and enterprises that aim to introduce artificial intelligence elements combining culture and teaching into the decoration design of the lab. The project has great value in inspiring students and serves as a specific reference for other schools to build artificial intelligence laboratories. Due to insufficient ability, traditional AI labs lack personalization and cannot display students' achievements. However, the interactive show-wall with smart home technology reflects the people-oriented characteristics of AI and is closer to daily life. Moreover, the show-wall is a dynamic construction that allows students to use the latest creative works to experiment with AI technology, allowing students to experiment with AI technology, creating a sense of achievement and inspiration for students who participated in the design.

Keywords: Interactive Show-Wall, Smart Home, Internet of Thing, Open-source Hardware.

1. Overview of the Interactive Show-Wall Project

Background

Traditional information technology laboratories often place various instruments and equipment and pay little attention to the cultural display. In our opinion, artificial intelligence is a mysterious subject for most students. If there is no cultural display in the laboratory, giving students or other visitors direct feelings is difficult: Where is the AI in the AI lab? What is the difference between this and an ordinary computer room? Therefore, we have specially considered how to display AI works in building an artificial intelligence laboratory. In order not to take up space, we think that we can use the wall space, with the wall as the medium, so that the user can directly communicate and interact with AI, so we have this interactive AI background wall project.

Project Objectives

After investigation, there are still very few AI laboratories in primary and secondary schools. AI laboratories in colleges and universities are white walls & wall paintings. On a white wall are images of AI scientists such as Alan Turing, John McCarthy, Calvin Minsky, and Arthur Samuel, which remain unchanged year-round. Such a laboratory is too ordinary to attract students. So how does AI Lab attract students to learn and practice AI? In our opinion, this AI background wall is the core of the whole AI laboratory and should have three functions:

(1) Static function: The background wall shall have AI-related patterns, such as the words representing the laboratory AI culture and some AI professional terms. These patterns, words, laboratory tables, chairs, and other equipment together form the overall cultural atmosphere of the laboratory.

(2) Dynamic function: The background wall should be variable along with the different applications, teaching scenes, and different cultures. Because there are many unique terms for artificial intelligence, it is not easy to display all of them on a wall, so this wall should be able to be changed and decorated at any time. For example, when you take an intelligent online course, you can change it into keywords related to intelligent online; when you take a computer vision course, you can change it into keywords related to image detection.

(3) Interaction function: AI works can be fixed on the background wall, or AI perception devices can be fixed and then interact with the smart home of the laboratory through these devices. The standard smart home uses a central control screen to control the entire home's smart home, and we can use an entire wall. The display must be fantastic if it is easy to fix. Imagine that every time students enter the laboratory, they cannot help interacting with artificial intelligence, so their learning and entertainment will be thoroughly combined.

For ease of presentation, the interactive AI background wall item will be called interactive wall from now on.

2. Implementation with Smart Home Technology

This part discusses the design and implementation of an AI interactive wall in a laboratory setting, integrating smart home technology. The AI interaction wall is a collection of intelligent home controllers with human-computer interaction, and it includes data acquisition, intelligent processing, and control output.

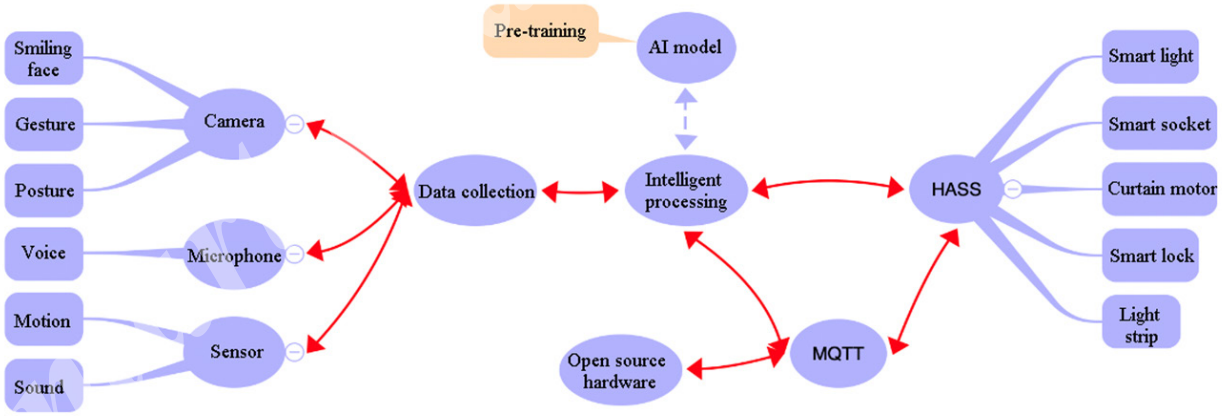

Figure 1 Workflow of AI Interactive Wall

The data acquisition involves cameras, microphones, lights, acceleration sensors, etc. The lab's home is a whole-home smart setup, integrating intelligent lights of different brands using an open-source smart home gateway, HASS. Some operations may involve remote control, so the MQTT protocol is

used, setting up an MQTT intranet server with SIoT software.

The AI interactive wall is designed to be static, dynamic, and interactive. The static function involves hand-painting the walls with acrylic paint, highlighting the characteristics of the laboratory. The dynamic function allows for the quick and dynamic adjustment of patterns or texts on the Knowledge Map node according to different courses. The interaction function is the core of the wall, completed by open source hardware and camera for perception (input), smart home devices for execution (output), and AI calculation (processing) part is flexibly deployed according to the complexity of the algorithm.

In this part, we also discusses the design of a control mechanism, similar to Mi AI, Siri, and Tmall Elf's wake-up words. The user first makes a specific gesture, and the controller sends a warning tone (voice) to indicate that the user has entered the recognition state.

The implementation with smart home technology provides a new direction for the application of AI in the field of human-computer interaction. It also highlights that the project provides a new solution for the automatic grading of fruits, reduces the burden of fruit growers, and promotes the excellent development of the fruit industry.

3. Conclusion

AI is originally an introverted intelligence, making it difficult to be explicit and display. Therefore, the traditional artificial intelligence laboratory is the same as the ordinary computer room without any characteristics. Although some schools also consider work displays, they can only buy AI works developed by major companies because of insufficient ability. As a result, they lack personalization and give people a feeling of ordinary; not only cannot do attraction but become an obstacle.

Although not the top in AI capability, the show-wall we designed reflects the artificial intelligence people-oriented characteristics and is closer to daily life because of the close connection with the smart home devices. What is more interesting is that the interactive wall is a dynamic construction. When students learn new artificial intelligence technology, they can use the latest creative works to replace the old works on the interactive wall. This interactive wall is a field for students to experiment with AI technology.

This project provides a good idea for constructing AI laboratories in many schools. According to the teacher's introduction, many school laboratory construction is entirely outsourced. Teachers and students have no opportunity to participate in the construction and are just users. If each school can add similar interactive walls in AI labs, the construction of AI labs will become a collaborative project between teachers, students, and enterprises. It is based entirely on real questions and situations and is project-based learning.

In addition, the works deployed on the interactive wall already have the function of products closely related to the real world. These works are also the tasks of the Entering the World of Intelligent Networks course, which will play an essential role in promoting artificial intelligence.

Project team members will continue learning AI-related technologies and enriching AI interaction walls. At the same time of optimization, we will also pay attention to the scheme arrangement and the writing of explanatory documents, including the scheme and technical realization path of the project, and strive to build the project into an open-source high-quality artificial intelligence education project for teenagers.

We hope that through the continuous improvement of this project, more students will feel the charm of AI and attract them to participate in the production of AI works. At the same time, we expect that the AI interactive wall can enter schools nationwide and the communities of various schools.

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Brief introduction of school and instructors

Wenzhou High School was founded in 1902. In 1953 it was confirmed as one of the 14 key middle schools in Zhejiang Province. In 1981 it was approved as one of the first 18 key middle schools in Zhejiang Province. In 2014, it was awarded the first batch of Zhejiang first-class ordinary high school characteristic demonstration School.

Zuoru XIE: Professor of information Technology. Director of AI Lab at Wenzhou High School in Zhejiang Province, China. Xie has a diverse range of research interests in Interdisciplinary Learning, Maker Education, STEM Education, and AI Education.

Dongsheng ZHU: Graduated from Fudan University majoring in computer science and technology. He has won the first prize of programming competition such as NOIP and the first prize of Information technology subject proposition competition of Zhejiang Wenzhou High School.

Executive Summary

09 An Intelligent Sensible System on Door Locker for Notification of Older People Lock-Forgetting

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Highlights

This project aims to provide a safe, practical, and affordable solution for older people who tend to forget to lock their doors. With the use of intelligent sensors, this device can detect and remind the elderly to close their doors in time, ensuring their personal and property safety.

Challenges: The aging population often struggles to adapt to new technologies, presenting various daily life challenges. This study seeks to assist the elderly by incorporating door alarm systems that detect open doors and uncollected keys without altering existing door lock structures.

Solution: A door magnetic switch was used for door status recognition. An infrared sensor was implemented to identify forgotten keys. A microswitch was used to set off a timeout alarm for unclosed doors.

Outcome: We developed a prototype set of smart door locks using open source hardware.

How does the Intelligent Sensible System for Door Locker work?

The Intelligent Sensible System for Door Locker is designed to have detection and alarm functions to remind the elderly to close the door in time. The system has two functional modules: one for judging whether the key is inserted into the door, and the other for judging whether the door is closed. The appropriate sensors and electronic modules are combined to realize these functions. When the system detects that the key is not removed or the door is not closed, it will sound an alarm to remind the elderly to take action.

What are the benefits of using this system for older people?

The Intelligent Sensible System for Door Locker provides several benefits for older people. Firstly, it helps to ensure their personal and property safety by reminding them to close the door in time. Secondly, it is safe, intelligent, economical, practical, and simple to install, making it a convenient solution for the elderly. Thirdly, it does not require changing the existing door lock structure, which reduces the cost and complexity of installation. Finally, it brings a sense of security to the minds of the elderly and has a specific deterrent effect on wrongdoers.

Can this system be easily installed on existing door locks?

Yes, the Intelligent Sensible System for Door Locker is designed to be practical, simple to install, and convenient for the operation of the elderly without changing the existing door lock structure. This means that it can be easily installed on existing door locks without the need for any major modifications. The purpose of the invention is to manufacture an intelligent door lock device that is simple to operate, low in cost, and strong in practicability, which can bring a sense of security to the mind of the elderly and have a specific deterrent effect on wrongdoers.

Executive Summary

Abstract

The project is to develop an intelligent sensible system for door lockers to notify older people of lock-forgetting, which is safe, intelligent, economical, practical, simple to install, and convenient to guarantee older people's personal and property safety. The device is designed to have detection and alarm functions to remind the elderly to close the door in time. The project focuses on finding the most suitable components through the detection test of different sensors to reduce costs and make the product affordable. The project aims to help the elderly around us to improve their personal and property home safety without changing the existing door lock structure and to bring a sense of security to the elderly's minds.

Keywords: Smart Door Lock, Older People, Home Safety, Intelligent Sensors.

1. Notficying the Lock Forgetting for Older People Project

In modern society, the aging problem is becoming more serious. According to statistics, in 2022, the population over 65 years old in China accounts for 14% of the total population. With the increasing aging population, our country is entering the aging era. As a result of the early family planning policies, many elders live separately from their children and live alone. The older person's physical condition worsens, body function gradually weakens, and memory and judgment ability both declines. Many older people often forget to pull out the key when entering the door or lock it because of their age and memory decline, so cases of stalking, burglary, and even robbery sometimes occur. Among the classmates in our team, there have been family members of them who suffer such a situation. We all think that there is a great possibility of a safety accident. Moreover, as China's aging becomes increasingly severe, a group of people gradually become old age. The number of elders will increase, so this kind of social problem will become more and more serious.

Developing a safe, intelligent, and economical sensible system on door locker is significant to the elderly. It can provide the first layer of guarantee for the life safety and property safety of the elderly.

According to our survey on the needs of the elderly around us, we believe that the safety of the elderly can be our research direction. After discussion and consultation, we decided to develop an intelligent door lock device that is safe, intelligent, economical, practical, simple to install, and conve-

nient for the operation of the elderly without changing the existing door lock structure to effectively guarantee the personal safety and property safety of the elderly.

The purpose of this research is to help the older people around us realize the alarm of not closing the door or not taking the key based on not changing the existing door lock structure at the lowest price to remind the older people to take off the key to the door in time and close the door, and protect the personal and property safety of the older people as much as possible. Therefore, the purpose of the invention is to manufacture an intelligent door lock device that is simple to operate, low in cost, and strong in practicability, which can bring a sense of security to the mind of the elderly and have a specific deterrent effect on wrongdoers. Therefore, we mainly focus on the following two research objectives:

(1) Manufacture a product with detection and alarm functions. For example, after the door is opened for some time, whether the door is closed or not is detected, and if the door is open, an alarm is given to remind the older people to close the door in time.

(2) The detection test of different sensors will find the most suitable components. In this way, the cost is reduced, the quality and the price are low, and more older people can accept the products. Therefore, let the product help more people.

2. Prototyping an Intelligent Sensible System on Door Locker

This part discusses the prototyping of an intelligent sensible system on a door locker. The project was carried out from January to August 2022 and involved various research methods, including investigation, experiment, and literature research methods.

The team surveyed at least 10 older people in their respective communities about their views on traditional door locks. The main concerns were that they often forgot to remove the key and close the door, which threatened their personal and property safety. Based on this survey, the team decided to focus their study around these two points. The team then embarked on the design and implementation of the intelligent door lock system. They considered how the door is opened and closed when making the model, the variation of each action, the measurement range of each component, and the voltage required for each element and the main control board. They also had to consider various complications, such as the need for a simple installation and issues with the sensor after rewiring.

The prototype of the door lock device was completed after many modifications. However, the team acknowledged that it still had many shortcomings. Some members gradually lost their enthusiasm for the project due to various factors such as too many assignments and time constraints, which negatively impacted the project's completion. The team participated in a summer camp for students on cross-strait computational thinking, which broadened their horizons and taught them how to do projects. They learned more about artificial intelligence and where to seek more professional knowledge in related areas.

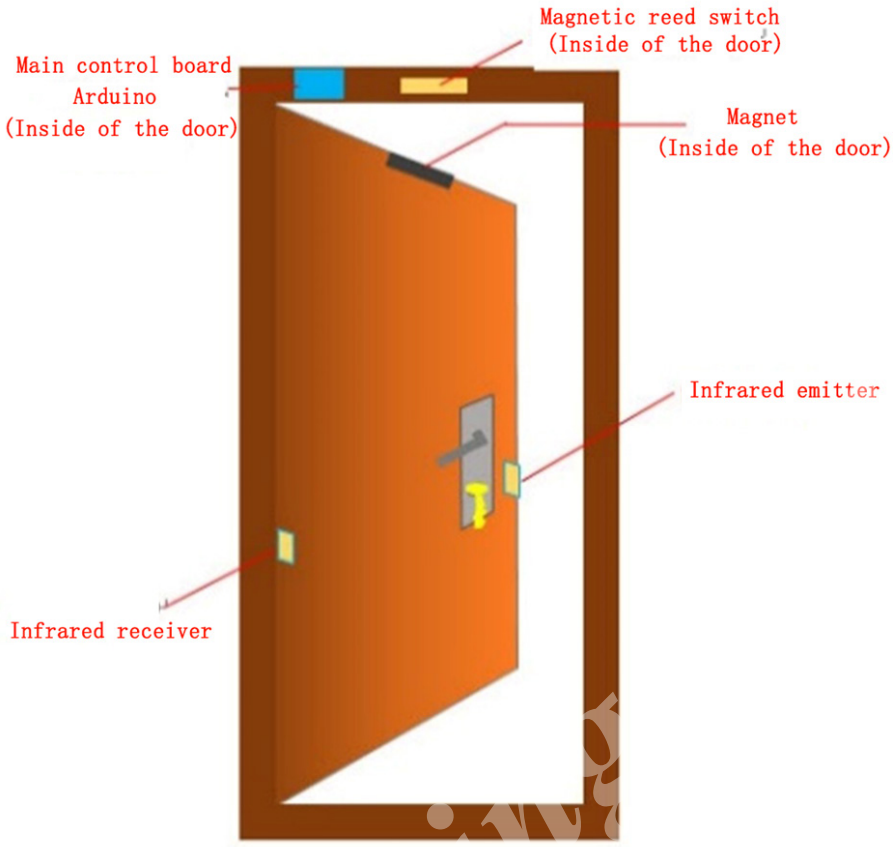

Figure 1 Schematic Diagram of Detection When the Key is forgotten to be Pulled Out

The challenges faced during the project and the lessons learned. It also highlights the importance of continuous learning and improvement in the field of artificial intelligence.

3. Conclusions and Future Plans

Through this project, we deeply realized that we have many shortcomings compared with others. We opened our eyes wider through this project. By seeking and reading the relevant literature, we know that a product is priced so high but still can be accepted and purchased because it can significantly facilitate people's life and provide convenient services for them. Although our products are not high in technology content, if we can add the service function of our products, they will be accepted by more people.

While doing the project, although we did not have the opportunity and time to learn the standardized programming language, we learned the mode of thinking. This activity made our logical thinking stricter and our thinking manner more diversified. At the same time, it also improved our part of the discipline accomplishment. For example, when comparing different sensors, we can only see the knowledge of sensor-related sensors in books, but we have no chance to practice it. Through this activity, we directly contact the sensor and understand its application method. Real knowledge comes from practice, and not all written books remain unchanged. We feel the gap between experimental and theoretical data.

Although the event is ending, our innovation is still not over. According to our phased discussion, our Smart Door Lock Device product can also dig deep into its capabilities by adding electronic modules to:

(1) Communication between the intelligent door lock device and the mobile phone can be added. By adding the WIFI module, the alarm signal that the door is not closed or the key is not taken off will be linked to the smart phone of the older person. The older person is better reminded to close the door and take the key through the secondary reminding function of the mobile phone.

(2) The automatic door-closing function of an intelligent door-lock device can be added. Now there are relatively mature door-closing products on Taobao. We can combine this product with our intelligent door lock device to make the door-closing operation more intelligent.

(3) The function of the doorbell can be added to expand the function of the intelligent door lock device.

All in all, through this project, we sweat and grow. Soon, we will apply the methods and skills learned in the project research process, keep the consciousness of innovation, and adhere to a rigorous work style to grow up better and faster.

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Brief introduction of school and instructors

Chengdu No. 17 High School, established in 1941, is an old public full high school with a moderate scale. It is an urban quality school with high reputation both inside and outside the industry, fine management, and excellent education, and can help students achieve diverse success.

Yunfeng ZHOU: Teacher at Chengdu No.17 High School. He has won Ye Deyuan Fund award, 2021 Jinjiang District Teaching Rookie, and 2020 Jinjiang District Teacher Teaching Skills Competition first prize.

Jia LAI: Graduated from the School of Computer Science of Sichuan Normal University and has been engaged in high school computer education for 17 years.

Executive Summary

10 Designing a Smart Car for Connecting Home and Community Delivery Pick-up Point

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Instructor: Lihuan WANG (E-mail: wanglihuan1106@sina.com).

Executive Summary

Abstract

The growth of online shopping and express delivery has resulted in an increased demand for last-mile delivery services, which is still being done through door-to-door delivery in many communities. This mode of delivery is costly in terms of time and resources. The unmanned trolley proposed by Smart Logistics is an intelligent device that can navigate autonomously and recognize its environment, making it a promising solution for express community delivery. This study analyzes the feasibility and application demands of the smart car in community express delivery and develops a solution that includes features such as path planning, automatic obstacle avoidance, and ultraviolet disinfection. The proposed system can improve delivery efficiency, reduce workforce, material, and time costs, and meet the needs of residents for timely express delivery.

Keywords: Smart Car, Community Express Delivery, Open Source Hardware.

1. Overview of the Smart Car Project

With the popularity of online shopping and the development of express business, many express enter various communities daily. Express delivery has become a closely related part of our lives. However, it is found through community field observation that the delivery mode of the last kilometer of express community delivery is still door-to-door delivery. The daily delivery volume of couriers is enormous. If they catch up with the promotion of merchants, the number of expresses delivered to residents in a limited time every day is extremely limited. The cost of manpower, material resources, and time is very high, and the delivery efficiency is low. In addition, many communities do not allow couriers to enter the community for door-to-door delivery to prevent close contact and reduce the probability of transmission and infection during the epidemic. The express can only be put at the community's door or a fixed station waiting for the owner to collect. However, the office workers in the city are busy in the daytime and often do not have time to pick up the express. The older people who live on high floors and are inconvenient to move are not convenient to go downstairs to collect the express. Some express may be lost or damaged if not picked up in time.

Delivery Problems between Home and Community Pick-up Point

Based on the above background, the community's express delivery has become an urgent problem to be solved nowadays. The unmanned trolley proposed by Smart Logistics is an intelligent device with various functions such as environment recognition, autonomous decision-making, and active driving, which relates to the technical fields of mechanical structure, information technology, artificial

intelligence, and so on. According to the preset mode, the unmanned trolley can complete corresponding actions in a specific environment with the advantages of automatic navigation, obstacle avoidance functions, strong stability, real-time performance, etc. It can be well applied to logistics transportation if a courier vehicle can automatically deliver goods to the designated households at the appointed time according to the express demand of the community. It can ensure that the community residents can get the express in time and improve the delivery efficiency of the express, meet the needs of epidemic prevention and epidemic prevention, and reduce contact with external personnel. In this way, great convenience can be brought to the lives of the residents.

2. Issues and Solutions of Automatic Community Delivery

This part discusses the issues and solutions of automatic community delivery using smart cars. The study was conducted through literature investigation, field investigation, and comparative analysis. The team identified three main problems that needed to be addressed: precise navigation and obstacle avoidance, access control and elevator access, and user interaction.

The precise navigation and obstacle avoidance problem is due to the complex community environment. The current accuracy of commonly used navigation software can navigate to the community's entrance, but the specific building in the community is seldom identified on the map. The team proposed marking the details of the community's roads and buildings on the car's built-in map.

The access control and elevator access problem is due to the variety of buildings in the district. Some doors need to be authorized, and some elevators are old and without a local area network. The team proposed using smart cards in place of robotic arms and combining them with a dispensing bin to solve the problem of getting on and off the elevators.

The user interaction problem involves confirming with the residents whether they are at home and whether it is convenient for the car to deliver the goods to their homes. The team proposed notifying the customer to pick up the goods and informing them of the password for taking them to prevent the incorrect goods from being taken and to confirm that the goods have been received.

The core features of the community smart car, includes route planning and obstacle avoidance, access control and elevator access, item access, and environment-friendly effort. The team proposed using a solar panel at one side of the car body to charge the car during driving and shutdown automatically, reducing power consumption and signal radiation.

3. Design and Simulation of Smart Car Prototype

The design and simulation of a smart car prototype for express delivery are the issues ot this part. The smart car includes several modules: the general control module, the execution module, the navigation module, the information communication module, the sense module, the man-machine interaction module, and the autonomous learning module.

The general control module acts as the central information processor. The execution module sends commands to each module. The navigation module has a built-in accurate map for path planning. The information communication module realizes the information transmission to the outside world and interaction with the control center. The sense module senses changes in the external environ-

ment and provides real-time information. The human-machine interaction module communicates with people around. The autonomous learning module, with the help of artificial intelligence, improves the ability to receive and analyze data so that the car can react more quickly and reasonably.

The smart car also has a built-in ultraviolet disinfection lamp placed at the top inside of each goods cabinet. When goods are detected, automatic disinfection is carried out to ensure the cabinet door is closed.

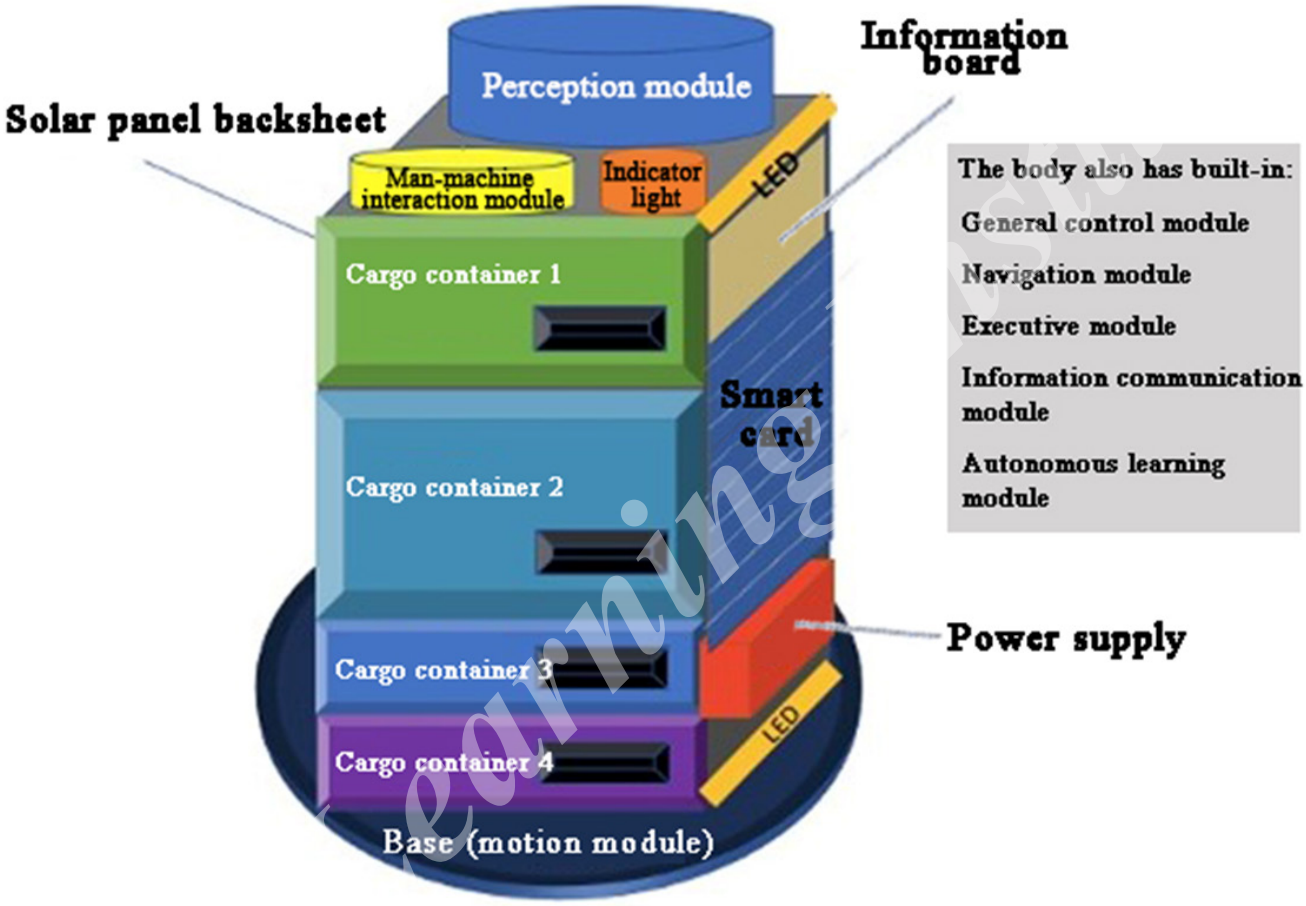

Figure 1 Schematic Diagram of the Smart Express Car

The operational simulation design involves the express delivery being put into the express cabinet of the smart car, generating a pickup code. The smart car, loaded with goods, begins to plan and optimize the delivery route and automatically detects whether the electric quantity is sufficient according to the total route length and the delivery time. The car starts from the starting point if the electric amount is predicted to be no less than 30% after it delivers goods.

4. Implementation of Smart Car Prototype

Based on the above research, we assembled an intelligent car under the teacher's guidance and debugged and ran it, and it realized most of the functions in our conception. The smart express car integrates a plurality of technologies. There is a general control module, which is the car's general control system. As the center of the control, with the help of a computer system, all the units need to integrate and interact with the available control module. The controller processes the data sent by the sensor module and then sends it to the drive module, thus controlling the movement of the whole

car and finally completing the automatic operation and control process. This trolley mainly comprises a control unit, an execution unit, a navigation module, a driving unit, a road identification and avoidance module, an information communication module, a human-computer interaction module, etc. The flow chart of the smart car's control system is shown in Figure 1.

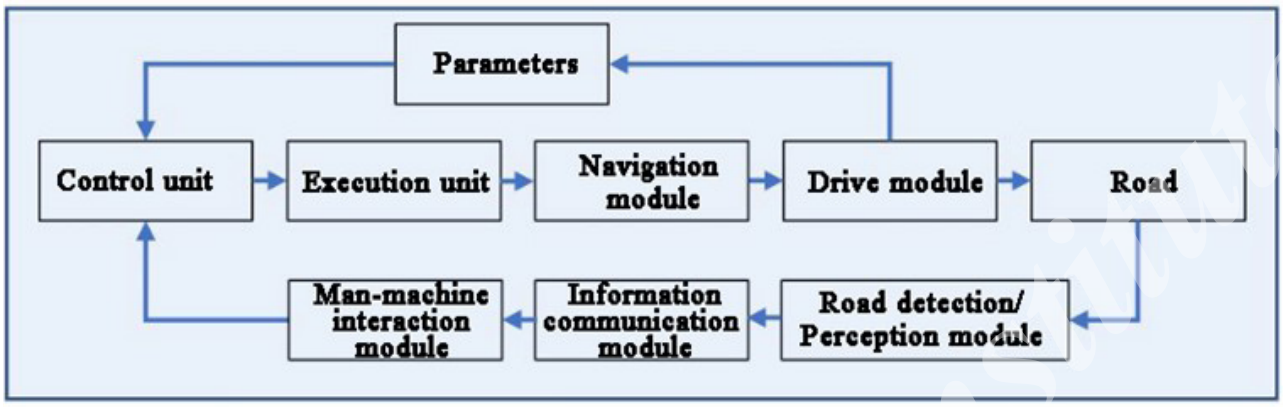

Figure 2 Flow Chart of Control System

The general control module acts as the central information processor. The execution module sends commands to each module. The navigation module has a built-in accurate map for path planning. The information communication module realizes the information transmission to the outside world and interaction with the control center. The sense module senses changes in the external environment and provides real-time information. The human-machine interaction module communicates with people around. The autonomous learning module, with the help of artificial intelligence, improves the ability to receive and analyze data so that the car can react more quickly and reasonably.

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5. Conclusion and Future Plans

The application value of the smart car has been demonstrated in some fields. This research uses literature inquiry, field investigation, and comparative analysis to analyze the application demands and feasibility of the smart car in community express delivery. The application development research is carried out according to the smart car's technical characteristics and operation scheme. According to the relevant technologies, the smart car is innovated and improved. The functions of information interaction, path planning, automatic obstacle avoidance, self-learning, ultraviolet disinfection, etc., are mainly realized, which can meet the needs of residents in the community to pick up the express, facilitate the courier, and the requirements of epidemic prevention. In practice, the smart car also needs to be perfected and improved. It will enhance the express mode to a certain extent, reduce the cost of workforce, material resources, and time, improve express efficien-

cy, and has good social and economic value. From the investigation of the project to the determination of the research scheme and then to the design and operation of the smart car, we have not only devoted to the project, expecting that the research can serve the practice, but also followed the clear research idea, adopted the appropriate research method, and solved the problem with the relevant knowledge of the smart car. In the research process, we are also constantly growing, gradually improving our essential character and critical ability to meet the needs of personal and social development.

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Brief introduction of school and instructors

Beijing Sanfan Middle School is the middle school of the Second High School affiliated to Beijing Normal University. The school implements all-round quality education to develop students' core qualities. Establish a diversified curriculum system, adhere to the student-oriented, and actively meet the needs of different students. The school actively explores interdisciplinary courses and other courses to cultivate new people who can adapt to future social development.

Lihuan WANG: Senior physics teacher in Sanfan Middle School and a backbone physics teacher in Beijing. In teaching with their own personality, behavior to infect the students, concerned about the overall growth of students. She advocates that students focus on the practical connections between life and the classroom.

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