Volume 3 Issue 2 · October 2019

ISSN 2591-7110 (print) ISSN 2591-7129 (online)

October

2019

MODERN ELECTRONIC TECHNOLOGY

02

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Volume 3 Issue 2 • October 2019
ISSN 2591-7110 (print) ISSN 2591-7129 (online)

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ARTICLE

Design of UAV Level Control Method

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ARTICLE INFO

Article history
Received: 28 May 2019
Revised: 10 June 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
UAV level control
UAV control
UAV
Drone

ABSTRACT

Starting from the current problems of drones, this paper aims to find solutions that are suitable for sustainable development. This paper mainly introduces a method of adjusting the control authority of UAV, including managing the process, obtaining the operation of maneuvering performance and controlling the accuracy rate. This method enhances the fault tolerance of UAV flight control, improves the high precision of UAV flight control, and avoids the occurrence of accidents caused by improper control, such as "drone damage" or "personal injury to others".

1. Introduction

In the era of quantitative change in science and technology, human's pursuit of quality has become more and more standardized. Therefore, high-end products have been more and more popular and valued, which has gradually become a strong market trend. UAV, a high-tech product, is well known and applied by more and more people. It integrates power and control[1], with advantages like low cost, zero casualty, reusability and high mobility.

With the widespread use of drones, how should drone operators standardize drone operations? How should drones be used professionally for operations? Whether there are solutions to flight safety problems of drones has also attracted the attention of many people. And how can drone operators solve the problems that new drone operators are likely to "blow up" the planes in a safer way. This paper

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Fund Project:
This paper is funded by the special construction project of "Innovation Strong School Project" in Guangdong Province and Zhujiang College, South China Agricultural University. The Project name is "Destructive innovative tourism products based on UAV AR Interactive Game" (Project No.: 201812623005S); This paper is also funded by the Higher Education Teaching Reform Project in 2017 (No. 706), namely The application, exploration and practice of WeChat public platform in college curriculum teaching under the environment of mobile Internet Plus.

 DOI: https://doi.org/10.26549/met.v3i2.1824

will look for solutions from a technical point of view.

2. UAV Background Introduction

As the name suggests, Drones, also knowns as remote-controlled driving vehicles, are aircrafts that are not operated by human pilots inside the flight is entirely dependent on the operator's remote proximity control on the ground[2]. The fuselage has automatic operating systems, such as program control systems, remote control and telemetry systems, to achieve all-round UAV flight control[3].

With the combination of various functions and industries, drones have owned a relatively complete industrial structure. UAV industry chain can be divided into research, development, manufacturing, product sales and product services. The increasing total amount and enhancing quality of drones will drive a large number of users and equipment in the future gathered together to form communities like aerial flight circle, air sports circle and so on. Moreover, integration effect, aggregation effect, synergy effect of the industrial value chain will be motivated[4]. It is the drive of market demand that makes drone gradually public[5].

UAV is now mainly used in military and civilian fields and the proportion of the use in civilian fields is constantly increasing. In the civilian field, drones can be applied in border patrols, resource exploration, disaster reconnaissance, communications relays, environmental monitoring, etc[1,2]. In addition, drone aerial photography can enhance the texture of the picture shooting, providing the film and television industry with production of irreplaceable visual effects.

With the development of UAV industry, its related service market is gradually growing and the industrial chain will be expanded. From the point of view of market size, the UAV Service market will have great investment value in the future.

3. Existing Problems and Preliminary Solutions to UAV Flight

3.1 Existing Problems of Drones

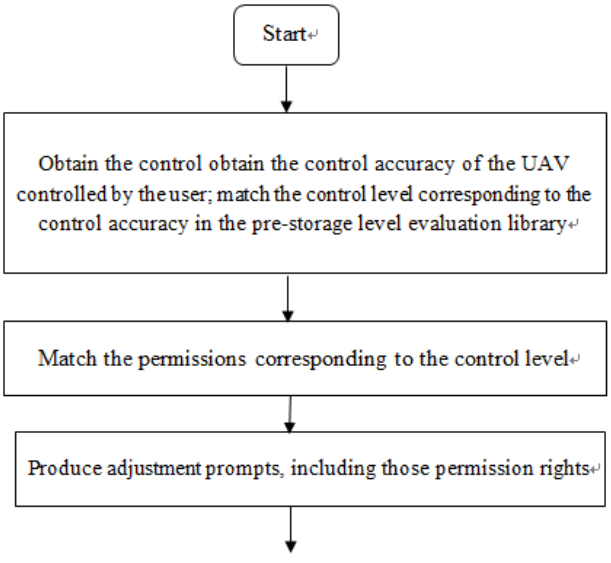
In recent years, the UAV industry has entered a stage of rapid development under various favorable factors. However, there is still detention of permission requirements of operators and blurred boundary between professional operators and novice operators. Additionally, the flight boundaries of drones are still unclear and most of the rules and regulations are not perfect[6]. At the same time, the growth rate of the number of drones is not proportional to the growth rate of their professional operators. This condition leads to a lack of knowledge of UAV flight policy and flight operation for novice drone operators, which may cause accident due to careless operation.

Every year, there are incidents in the world that affect the normal operation of the airport due to improper use of drones. In recent years, there are some illegal drone flight incidents occurred in some airports in China that have serious effects. For example, at Hangzhou International Airport, a drone broke into the airport clearance reserve, interfering with the normal flight of the aircraft and affecting the flight safety of the aviation[7]. Such incidents not only pose a threat to air transport flight safety but also have an impact on social public safety[8]. The usual treatment for such incidents is the restriction of drones' flight in some areas or the use of UAV counterattack gun to shoot down the aircrafts. These initiatives can reduce illegal drone flight in a short period of time, but in the long run, it is worth pondering how much these initiatives can regulate drone flight chaos.

Nowadays, the UAV is controlled by remote controllers, and the UAV operators can decide the flight height or speed in non-restricted flight areas of their own initiatives. Such control methods with free control rights are poor in fault tolerance and are easy to cause accidents due to improper control in non-restricted flight areas, such as damage to drones or personal injury to others.

3.2 Preliminary Solutions to UAV Flight Problems

In view of the flight control defects of the existing UAV mentioned above, a method of UAV level control authority comes into being, which provides guarantee for the new operators in UAV operation. Its permissions include speed permissions, distance permissions, and one or more features in the control dimension permissions. It can be divided into four steps.



DOI: https://doi.org/10.26549/met.v3i2.1824

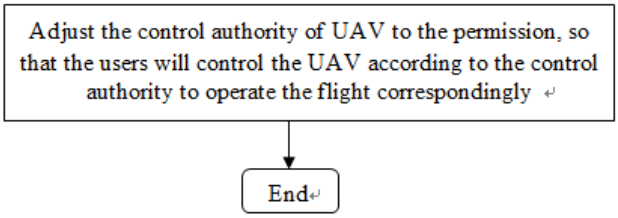


Figure 1

Step one is to obtain the control accuracy of the UAV controlled by the user, and to match the control level corresponding to the control accuracy in the pre-storage level evaluation library. Step two is to match the license permissions corresponding to the control level. And step three is output of adjustment prompts, including those of permission rights. While in step 4, The current control authority of the UAV is adjusted to the permission, so that the users will control the UAV according to the control authority to operate the flight correspondingly. After this step, the method also includes repeating step one to step four per preset time period to adjust the control permissions of the UAV.

The above is a preliminary solution to the defects of UAV operation flight. This method gradually carries on the corresponding matching dispatching for novice UAV operators, making it possible for them to use UAV in a more accurate way and avoid safety accidence caused by mis-operation.

4. The Concrete Implementation Mode of UAV Level Control Method

In order to interpret this paper more clearly, the following will be a logical and comprehensive description of the technical methods of this paper through UAV manipulation embodiments and drawings.

4.1 The procedures of drone control permission method

Firstly, the control accuracy of the user control UAV is obtained, and the control level corresponding to the control accuracy is matched in the pre-storage level evaluation library. The actuator of the adjustment method of UAV control authority can be the adjustment device of UAV Control authority, the control device of UAV, the mobile devices, terminal devices, etc. The adjustment method of the drone control authority of the service is applied to the adjustment devices mentioned above, and the control accuracy of the UAV can be obtained by the user under the adjustment device when the user first initiates the control of UAV.

Next, it will match the permissions that correspond to the control level. The control level includes four levels, namely entry, elementary, intermediate, and advanced levels. Licensed permissions include controlling the maximum flight speed of UAV flight, controlling the farthest distance of UAV flight, controlling the control dimensions of UAV flight and so on. The control dimension includes controlling the back-and-forth, up-and-down and left-and-right movement of UAV. And it can also include the controlling of rotation of UAV.

The next step is producing permission adjustment prompts that include the licensed permission. Finally, the current control permissions of the UAV are adjusted to licensing permissions so that the user controls the drone to perform the corresponding flight operation according to the control rights. When the control instructions entered by the user are received, it will determine whether the control permissions of the current drone include the permissions corresponding to the control instruction. If included, it control the drone to perform the corresponding flight operation according to the control instruction. If not included, the instruction should not be followed and the No-action permission prompt will be produced. After they are confirmed as control permissions for the drone, it can determine the current unlicensed permissions based on both the permissions and the full permissions that are stored. Based on the current unlicensed permissions, the current unlicensed permissions will automatically control drone flight.

4.2 Methods for Obtaining Accuracy Rate of UAV Control

With regard to the acquisition of the accuracy method of UAV control, it is necessary to obtain the control accuracy of the UAV controlled by the user according to the characteristics of the UAV Control permission adjustment methods. This includes obtaining the dynamic flight pictures on the UAV, virtual dynamic images, virtual flight route images and dynamic flight images generated from the sensor data collected by various sensors on UAV. And the augmented reality screen are produced and shown based on the virtual dynamic images and virtual flight route images. The actual route of the UAV flight is shown on the augmented reality screen, and the coincidence rate between the actual route and the virtual flight route is determined as the control accuracy rate.

Firstly, get the current flight route and determine the coincidence rate between the flight route and the preset route.in order to determine the coincidence rate, it includes obtaining the flight view and flight route of the UAV, superimposing the preset route in the flight view

 DOI: https://doi.org/10.26549/met.v3i2.1824

and obtaining the virtual reality view, where the flight route is displayed and the coincidence rate between the flight route and the preset route can be determined.

Then the corresponding error correction model is obtained according to the preset route, and the control accuracy rate obtained by using error treatment of coincidence rate according to the error correction model, The error correction model is used to compare the actual flight route with the preset one and obtain the coincidence rate. After that, it can determine whether the coincidence rate is lower than the preset threshold. If it is lower, it suggests that the coincidence rate of the flight route and the preset route is relatively low. Through adjusting the value of error band width in the error correction model, which means increasing the line width of the preset route, and comparing the flight route with the adjusted preset one, the corrected coincidence rate is obtained. Then, whether the difference between the corrected coincidence rate and the original coincidence rate exceeds the change threshold should be decided. If it exceeds the change threshold, it indicates that there is mutation of the modified coincidence rate, therefore the flight route is abnormal, which needs to be re-determined. If it doesn't exceed the change threshold, it indicates that the change of corrected coincidence rate is normal and the corrected coincidence rate will be used as the control accuracy rate. The greater the error bandwidth in the error correction model, the higher accuracy of obtaining users' control accuracy rate of controlling UAV. The size can either be set by the user or automatically set by the adjustment device.

4.3 UAV Control Accuracy Calculation Process

Before the flight, the system will determine the flight route based on the user's chosen pass points and define the route as the perfect track for drone flight. At the same time, the user input UAV flight preset width x_0, flight accuracy p is the relative ratio of preset flight effect and actual flight effect the moment the plane takes off. According to the definition, the accuracy rate of UAV flight within the preset width is calculated by 100%.

During the flight of the drone, the system will obtain the real-time deviation value x of the UAV and the instantaneous velocity v at the current direction of the perfect orbit every Δt time. Therefore, at every Δt moment, the real-time coincidence rate c and flight distance of the drone s will be calculated. $c = \frac{x_0}{x} \times 100\%$, $s = v \times \Delta t$.

If the distance the UAV deviates from the perfect track is longer, the coincidence rate and accuracy rate of flight will be lower. So it can be suggested that the accuracy of the UAV flight over a period of time is related to the real-time orbital width of the flight. And the same coincidence rate can be maintained if the UAV flies in the same orbit in the direction of the perfect orbit. If the flight distance is different, the accuracy of the flight will be not the same. Taken together, we can conclude that the flight accuracy of the drone is related to the distance of its forward flight.

To sum up, according to the various contributory factors in the flight process, the relations among the accuracy rate every Δt moment, the coincidence rate (that is, the real-time flight track width) and the distance of is forward flight can be concluded as:

$$p_i = \frac{p_{i-1} \times S_{i-1} + c_{i,1} \times s_{i,1} + c_{i,2} \times s_{i,2} + \cdots + c_{i,m} \times s_{i,m}}{S_{i-1} + S_i}$$

p_i is the accuracy rate of the i^{th} time. $c_{i,1}$、$s_{i,j}$ $\left(j = 1,2,\cdots,m,\ m = \frac{\Delta T}{\Delta t}\right)$ indicates the i^{th} time coincidence rate and the calculated real-time flight distance according to the i^{th} time coincidence rate. $S_i = s_{(i,1)} + s_{(i,2)} + \ldots + s_{(i,m)}$ suggests the flight distance along the perfect track during the period between the $i\text{-}1^{th}$ time and i^{th} time accuracy rate.

The control accuracy of the i^{th} time flight is judged by the correlation among flight accuracy, permission and control level derived from the -1th time.

If the $i\text{-}1^{th}$ time control level is 2 and $p_i<50\%$, it will adjust error broadband, which means adding the preset orbit width $\Delta x = \frac{x - x_0}{2}$. If $\frac{\Delta x}{x} > 0.2$, the system will give a degrading prompt. Otherwise, the existing level 2 will be maintained. However, if $p_i<50\%$, level 2 will be maintained.

If the $i\text{-}1^{th}$ time control level is 3 and $p_i<70\%$, it will adjust error broadband, which means adding the preset orbit width $\Delta x = \frac{7x - 10x_0}{10}$. If $\frac{\Delta x}{x} > 0.15$, the system will give a degrading prompt. Otherwise, the existing level 2 will be maintained. However, if $p_i<70\%$, level 3 will be maintained.

If the $i\text{-}1^{th}$ time control level is 4 and $p_i<85\%$, it will adjust error broadband, which means adding the preset orbit width $\Delta x = \frac{85x - 100x_0}{100}$. If $\frac{\Delta x}{x} > 0.15$, the system will give a degrading prompt. Otherwise, the existing level 2 will be maintained. However, if $p_i<50\%$, level 4 will be maintained.

4.4 The Relations Among Control Accuracy Rate, Control Level And Permission

The corresponding relations among control accuracy rate, control level and permission are as follow. When the control accuracy is P<50%, the maximum flying speed for permission is 3m/s ,the farthest control distance is 150m and the control level is 1 when controlling the forward movement of the dimension. The detailed relations of control level 2, 3 and 4 are shown in Figure 2.

DOI: https://doi.org/10.26549/met.v3i2.1824

Control Accuracy Rate(p)	Control Level	Permissions		
		Maximum Flying Speed	Maximum Distance	Control Dimension
p<50%	1	3m/s	150m	back-and-forth movement
50%<p<70%	2	5m/s	300m	back-and-forth movement, left-and-right movement
70%<p<85%	3	10m/s	600m	back-and-forth movement, left-and-right movement , up-and-down height adjustment
85%<p<100%	4	15m/s	1500m	back-and-forth movement, left-and-right movement , up-and-down height adjustment, diagonal movement

Figure 2

The user can perform the matching flight operation of the UAV according to the control rights or manually adjust the control permissions of the current UAV, while control level corresponding to the control permissions that the user can manually adjusts can only be less than or equal to the control level corresponding to the current control permissions. For example, assuming that control permissions are divided into four levels, which are entry, elementary, intermediate, and advanced level, and that the control level for the current control permissions is intermediate, the control permissions that the user can switch manually can be of entry, elementary and intermediate level.

5. Conclusion

To sum up, this paper puts forward a UAV level control method which can improve the safety factor of UAV operators from the analysis of the general management problem of UAV under the background of the development of UAV industry nowadays. This paper discusses in detail the process of the method, how to obtain and calculate the accuracy of the method, and then determine the flight grade of the UAV operator. Additionally, the safe use of the UAV can be guaranteed effectively by matching the UAV operators and their flight control degree accordingly based on the relations among control accuracy rate, control level and permissions.

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 DOI: https://doi.org/10.26549/met.v3i2.1824

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ARTICLE

Research on Auto-Exposure Algorithm Based on Image Big Data and Information Entropy

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ARTICLE INFO

Article history
Received: 8 August 2019
Revised: 9 August 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
AE
Big data
Information entropy
Ambient luminance

ABSTRACT

An Auto-Exposure (AE) algorithm based on image big data and information entropy is proposed. On the basis of the traditional algorithm for automatic exposure adjustment based on image brightness, image big data analysis is introduced for the first time. Through the combination of ambient luminance evaluation and image information entropy, the dimension of information acquisition of the automatic exposure system is improved, thus improving the image effect and scene adaptability of the camera. Especially in high dynamic range scenes, compared with the traditional algorithm, the effect is significantly improved.

1. Introduction

With the rapid development of today's society and the progress of science and technology, the need to ensure social security and the safety of people's travel has become increasingly prominent, and the intelligent security industry has gradually entered into people's vision. As the main front-end acquisition equipment in the field of security monitoring, digital cameras are the foundation and premise of all subsequent security functions. Only by continuously improving the image effect and collecting more abundant information can the functions of back-end image analysis and identification be effectively realized. As the core function of determining the image effect, the AE of the camera occupies an increasingly important position. The principle of AE is to dynamically control and adjust the camera's exposure time, gain of the camera according to the brightness information of the digital image received by the image sensor, so as to achieve the image brightness effect suitable for human eyes' senses. The feasibility of the AE algorithm described in this paper has been fully verified in cameras in the field of intelligent traffic and monitoring such as the solution of the Hisilicon 3559A processor matched with Sony CMOS sensor IMX305, and remarkable results have been achieved.

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DOI: https://doi.org/10.26549/met.v3i2.2216

2. Research Background

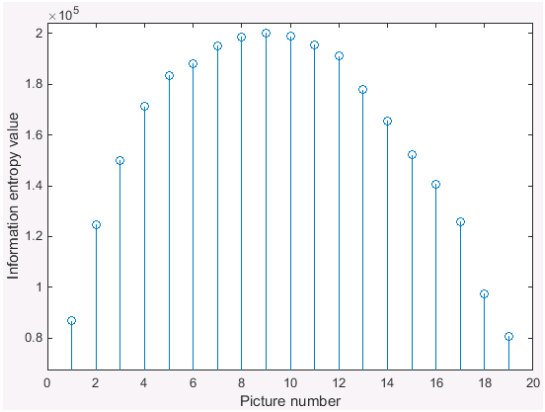
For the AE algorithm of the camera, the traditional research direction is based on the average brightness of the image[1] or the weighted average brightness based on the region of interest (ROI)[2], as the photometric reference of the image, or based on the method of dynamic adjustment of the image information entropy to obtain the maximum value[3] as the target of AE. However, camera equipment in the field of intelligent security is widely used in indoor and outdoor scenes with various brightness, contrast and dynamic range, and the above methods have obvious problems in scene adaptability.

(a) AE effect of average brightness statistics

(b) AE effect of ROI weighted brightness statistics

Figure 1. Defects of Traditional AE Mode Based on Image Brightness in Different Scenes

(a) Pictures of different exposures in the same indoor scene



(b) Information entropy corresponding to the picture

Figure 2. Statistical Results of Traditional AE Algorithm Based on Image Information Entropy

Figures 1 and 2 are typical scene pictures captured by current security cameras. Figure 1(a) shows the effect of AE algorithm using the global average brightness mode. In a high dynamic range scene, the average brightness of the image is increased due to the high brightness of the background, the foreground picture is too dark, and the details are difficult to be clearly displayed. Figure 1(b) shows the effect of AE algorithm based on ROI weighted brightness statistics. Since the pavement texture is rich, it is selected as the area with larger ROI weight, which is the main reference for AE adjustment. Moreover, due to the fact that the road surface is in the shadow range, the average brightness of ROI is low, therefore, the overall brightness of the image is improved, resulting in serious overexposure of background plants and loss of effective information. Figure 2(a) shows the images captured in an indoor monitoring scene with the exposure value from low to high. Figure 2(b) shows their corresponding image information entropy. According to the traditional information entropy maximum algorithm, the ninth picture in figure 2 (a) should theoretically be the optimal effect of AE adjustment, but in the actual use process, after the long-term testing, the seventh picture takes into account both the indoor scene and the information outside the window, and is most in line with human eyes' senses in terms of brightness and visual effect. In other words, in terms of visual effect, the image of the maximum information entropy is not necessarily the most suitable for human eyes' senses.

In addition, image big data has been gradually applied in the image processing of the traffic field, which is mainly reflected in the extraction of illegal or violation information from captured images, thus maintaining urban

 DOI: https://doi.org/10.26549/met.v3i2.2216

traffic safety [4]. However, there are still some gaps in the fields of mining images themselves and the combination of AE algorithm and big data.

3. Methods

Aiming at the adaptability defects of the traditional AE algorithm, this paper proposes an AE algorithm based on image big data and information entropy. The basic idea of this algorithm is to raise the dimension and add the ambient luminance evaluation index on the basis of the evaluation of the image by the traditional AE algorithm, so as to dynamically adjust the brightness weight of each gray level pixel in the image histogram area and obtain the weighted image brightness. At the same time, using the information entropy evaluation method [5] and the analysis and mining of large image data, the optimal parameters are obtained. The brightness of the set AE target is adjusted, and then the magnitude and direction of exposure are determined according to the relationship between image brightness and target brightness, thus achieving the purpose of AE adjustment. We have collected about 3 million pictures captured by monitoring and intelligent traffic cameras in different locations across the country under different climates, environments and light intensities, forming a large data set of pictures for typical scenes of intelligent security monitoring for the determination of subsequent algorithm parameters. The basic flow of the algorithm is shown in Figure 2.

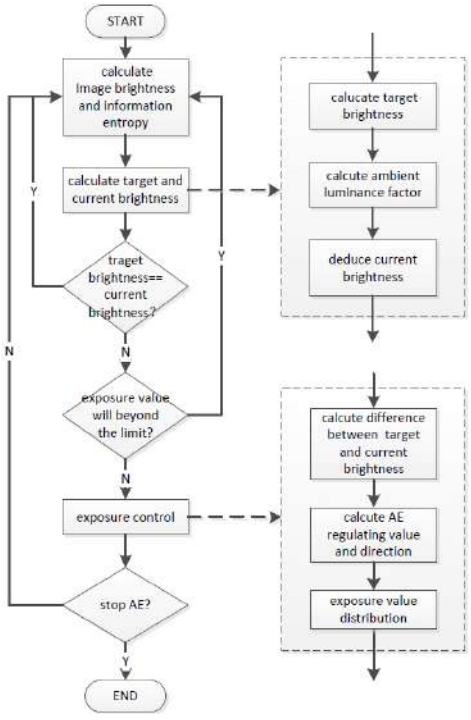


Figure 2. Algorithm flow chart

First, based on the continuity of camera frame information and illumination[6,7], the information of the Nth frame can be used as the basis for calculating the exposure value of the N+1th frame. From the image brightness histogram hist, the probability $p_{(i)}$ of obtaining the i-th histogram is:

$$p_{(i)} = hist_{(i)}/(h * w) \tag{1}$$

In an 8-bit digital image system, the value range of i is from 0 to 255, h and w are the height and width of the image respectively, and then the information entropy E of the frame image is obtained according to the information entropy calculation formula:

$$E = \sum_{i=0}^{255}(-p_{(i)}) * \log(p_{(i)}) \tag{2}$$

The average brightness of an image can be obtained by the following formula:

$$L_{avg} = \sum_{i=0}^{255}(i * hist_{(i)})/(h * w) \tag{3}$$

Image information entropy can reflect the richness of a frame of image information. In theory, the human visual effect should be optimal for the frame with the largest information entropy. However, through the analysis of large image data and the contrast test between image information entropy and human eyes' senses, we have come to the conclusion that there is a certain deviation between the information entropy optimal image and the human eyes' senses optimal image. This is because the image information entropy is greatly affected by the image texture richness, noise and other factors[8], while the human eye is less affected.

Based on the mining and sorting of large image data, we have made a series of attempts in the direction of AE adjustment guided by the mixture of target brightness and information entropy. Finally, we have worked out an optimization scheme, which is based on the image information entropy E, the new image target brightness is obtained according to the system target brightness input from outside and the image information entropy threshold value :

$$L_{tar} = L_{in} - l_{unit} * \max(0, (\frac{E - E_{th}}{E_{uint}})) \tag{4}$$

In the formula, is the weight of target brightness compensation, is the unit of image information entropy calculation and is the target entropy value. In order to reduce the number of parameters, is uniformly set to 128 at the time of data capture to keep the image from being darker in each scene. Based on formula (4), it could obtain that

DOI: https://doi.org/10.26549/met.v3i2.2216

$$L_{tar} = L_{in} - \max(0, (\frac{E-E_{th}}{t})) \quad (5)$$

Among them, $t=E_{uint}/l_{unit}$. The determination of the above parameters is completed through the strategy of data iteration. Based on the big data set of images of typical scenes in intelligent security, we first carry out pre-processing operations such as image scaling to reduce the image size and facilitate processing while preserving histogram information. Then, according to the optimal effect periods of different cameras, the data set is divided into two subsets A and B, A is the collection of captured pictures within the optimal effect period of each camera, with about 1.8 million pictures and B is the set of pictures to be optimized, with about 1.2 million pictures. In the data collection, 20,000 pictures are randomly selected to form sub-data sets a and b as initial data sets for image analysis. After the data set is determined, the images in the set are first analyzed to obtain the target information entropy E_a, and then the data set b is mined and sorted to start the iteration of parameters. The specific process is as follows: For recording each picture L_{in} in the b set, the initial value of t is set to 1/10000, and the initial value E_{th} is set to E_a, and substitute each parameter into formula (5) to obtain a new L_{tar}. As the exposure time and gain of the image are approximately linear with the brightness of the image, we use python language to perform linear processing in pixel domain for the picture in b, L_{tar} is the brightness of the image. As the next iteration, L_{tar} is as L_{in}. The L_{tar} difference between the previous and the following two iterations is gradually reduced through the iterative process of adjusting the parameters, so as to achieve the purpose of convergence. In the process of convergence, the parameters are substituted into data set a for correction of E_{th} after each of the iteration. After the evaluation function has fully converged, gradually increase the number of samples of data sets a and b and fine-tune the parameters until the function convergence requirements of the whole data sets A and B are met. According to our experimental results, the parameters begin to converge in the second round of iteration and reach basic stability in the seventh round. Finally, $l_{unit}=2$, E_{uint}, is 3500, and E_{th} is $2.9*10^5$, which are taken as the fixed parameter of formula (4) for the calculation of target brightness.

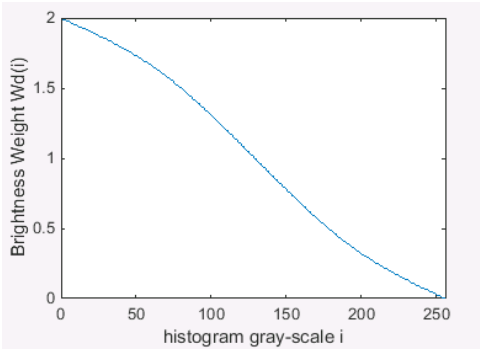
Next, according to the exposure time S and gain G of the current system, using the input target brightness L_{in} and fixed basic target brightness L_{base} of the system, as well as the maximum exposure time S_{max} and maximum gain value G_{max} of the system, the external environment brightness proportion value of the current frame can be obtained:

$$f_t = S * G * (L_{in}/L_{base})/(S_{max} * G_{max}) \quad (6)$$

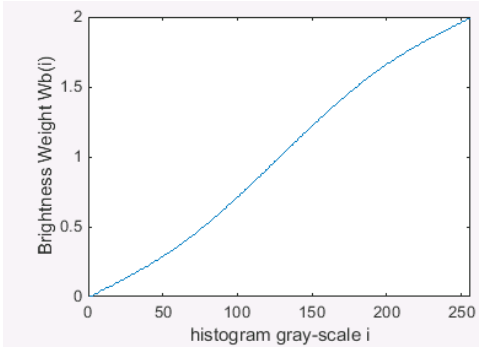
The L_{base} here is 100. Since the exposure time S cannot be 0, it can be seen from the formula that the value range of f_t is (0, 1]. The larger the f_t is, the smaller the brightness of the current scene is. According to the brightness coefficient f_t of the external environment, the ambient luminance factor f_{env} in the current scene is obtained:

$$f_{env} = \begin{cases} f_{min}, & f_{env} \le f_{min} \\ f_t, & f_{min} < f_{env} < f_{max} \\ f_{max}, & f_{env} \ge f_{max} \end{cases} \quad (7)$$

f_{min} and f_{max} indicate the upper and lower limits of the f_{env} values, taking 0.3 and 0.7 respectively in practical application. For brightness histogram, the lower the ambient luminance is, the greater the weight of darker part of the image should be to promote the AE system to adjust in the direction of increasing the image brightness. On the contrary, the greater the ambient luminance is, the greater the weight of highlighted part of the histogram should be. As shown in figures 4 (a) and 4 (b), for the scenes with dark and bright ambient luminance, there are histogram brightness weight functions and :



(a) the ambient luminance is darker



(b) the ambient luminance is brighter

Figure 3. Histogram Mapping Weight Curve in Different Ambient luminance

 DOI: https://doi.org/10.26549/met.v3i2.2216

According to the ambient luminance f_{env}, the formula can be used:

$$W_f=W_d*f_{env}+W_b*(1-f_{env}) \quad (8)$$

Calculate the fitted histogram brightness weight function W_f as the weight mapping basis for calculating the current image brightness, and then according to:

$$L_f=\sum_{i=0}^{255}(i*hist_{(i)}*W_{f(i)})/(h*w) \quad (9)$$

Obtain the final brightness value L_f of the current image. After the above steps, on one hand, we correlate the brightness of the frame image itself with the ambient luminance through the brightness weight W_f generated by the environmental luminance factor f_{env} to obtain the mapped image brightness L_f; on the other hand, we integrate the image information entropy into the AE target brightness and calculate the final target brightness L_{tar} generated by the combination of the two by using the parameters obtained by big data analysis.

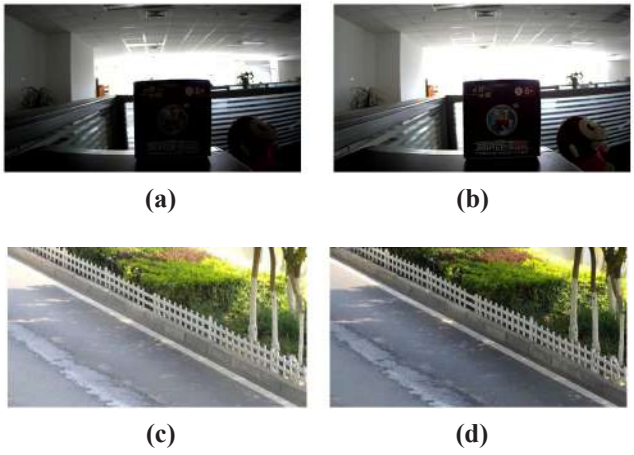
Next, compare L_{tar} and L_f , and calculate the exposure deviation *ΔEXP* according to the following formula as the adjustment target for the next frame:

$$\Delta Exp=\sqrt{L_f/L_{tar}} \quad (10)$$

Finally, according to the exposure adjustment formula $\Delta Exp=\Delta_S+\Delta_{GD}+\Delta_{GA}$, the increments of exposure time S, digital gain G_D and analog gain G_A of the camera system are dynamically allocated. The exposure increase is based on the principle of priority $S>G_A>G_D$; and the exposure decrease is based on the principle of priority $G_D>G_A>S$.

6. Comparison Results

This algorithm has been applied and verified in the security monitoring and intelligent traffic scheme based on Hisilicon 3559A processor and Sony IMX305 image sensor, as shown in Figure 4



(a) **(b)** **(c)** **(d)** **(e)** **(f)**

Figure 4. Comparison of effect between traditional AE algorithm and the algorithm in this paper

(a), (c) and (e) of Figure 4 are effect diagrams of average brightness AE algorithm, ROI weighted AE algorithm and information entropy maximization AE algorithm respectively, (b), (d) and (f) are the effect diagrams of AE algorithm in this paper. By comparing the pictures, it can be seen that the AE algorithm based on ambient luminance and image information entropy effectively solves the adaptability problems in the traditional AE algorithm, and can obtain better results whether dealing with wide dynamic, high contrast or scenes with rich details.

7. Conclusion

This paper proposes a new AE algorithm based on image big data and information entropy. It is the first attempt to combine big data and automatic exposure algorithm, which provides a new direction for the development of AE algorithm. On one hand, the AE adjustment direction is guided by the combination of image information entropy and target brightness based on the mining and sorting of image big data; on the other hand, ambient luminance factor is introduced to assist image information statistics; at the same time, the exposure combination factor is dynamically adjusted to achieve the purpose of adjusting the exposure parameters in real time. The algorithm is easy to implement and has strong adaptability to scenes. In actual tests, it solves the adaptability defects of traditional AE algorithm, and can always maintain good image effect regardless of the changes of environment and dynamic range. The algorithm has been widely applied to the front-end acquisition equipment in the field of intelligent security and has broad commercial prospects.

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DOI: https://doi.org/10.26549/met.v3i2.2216

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 DOI: https://doi.org/10.26549/met.v3i2.2216

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ARTICLE

RTL Implementation of White Balance Algorithm Based on ZYNQ

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ARTICLE INFO

Article history
Received: 8 August 2019
Revised: 9 August 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
White balance
ZYNQ
RTL
Gray world

ABSTRACT

In view of the common automatic white balance algorithm complexity is too high and the characteristics of the hardware to realize real-time. This paper combines gray world model and the advantage of white point detection algorithm, an adaptive control process is used to calculate gain coefficient and to picture the three-component white balance correction. On this basis to realize the automatic white balance based on the ZYNQ RTL implementation of the algorithm. Compared with the traditional method, the cost of hardware is reduced, and the efficiency and flexibility of the algorithm are improved. Experimental results show that the algorithm can run smoothly and realize accurate correction of off-color images.

1. Introduction

White balance is a very important concept in the field of television camera. White balance is produced with the reproduction of color reality in electronic images. White balance was applied earlier in the field of professional photography, and is now widely used in household electronic products (household video camera, digital camera). The white balance algorithm includes manual white balance and automatic white balance. This paper briefly introduces the automatic white balance algorithm and the ZYNQ implementation of the algorithm.

2. Key Technical Analysis

2.1 ZYNQ

The ZYNQ-7000 scalable processing platform is the latest in a series of products using the same 28nm programmable technology as the new generation of syringes fpgas (artix-7 and kintex-7fpga). Programmable logic can be configured by the user and connected together through "interconnect" modules, which can provide user-defined arbitrary logic functions to extend the performance and functionality of the processing system. However, unlike fpgas with embedded processors, the ZYNQ-7000 family of processing systems can not only be started at boot time, but can also be configured with programmable logic as needed. With this approach, the software programming model is identical to the full-featured standard ARM

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DOI: https://doi.org/10.26549/met.v3i2.3080

approach to SoC. The white balance algorithm can be realized efficiently and quickly by using the advantages of ARM and FPGA.

2.2 Constancy of the Color

The color is not an actual thing; it is just the result of our brain and retina processing. One of the special functions of our visual system is to be able to determine the true color of an object even when the light source changes, a robustness that computers and other processing machines do not have. Color constancy, also can be understood simply, under the circumstance that outside illuminant changes, still can retain the object original color. We study color constancy and come up with algorithms that aim to make computers have this special function of the human vision system, restoring the original color of an image under different light sources. According to the sensory judgment of human eyes, when the color temperature is 6000 K(kelvin), we evaluate that the color of the image we see is white, while in other color temperatures, the image we see is biased. We hope to correct this display phenomenon called white balance through the algorithm.

2.3 Grayscale World Algorithm

In Marc Ebner's monograph Color Constancy, Gray World algorithm of white balance is proposed. The grayscale world algorithm is based on the grayscale hypothesis, which holds that: for an image with a large number of color changes, the average value of the three-color components R, G and B will tend to the same grayscale value. In the physical sense, the grey-world method assumes that the mean value of the average reflection of natural objects to light is, on the whole, a definite value, which is approximately "grey". The white balance algorithm applies this assumption to the image to be processed, which can eliminate the influence of ambient light from the image and obtain the original scene image.

Suppose the average value of the three color components R,G and B approaches to X:

$$K=(R_{ver}+G_{ver}+B_{ver})/3 \quad (1)$$

Where R_{ver}, G_{ver} and B_{ver} represent the mean values of red, green and blue color channels respectively. The gain of channel R,G and B is defined as Xr, Xg and Xb respectively:

$$X_r=X/R_{ver} \quad (2)$$

$$X_g=X/G_{ver} \quad (3)$$

$$X_b=X/B_{ver} \quad (4)$$

According to the Von Kries diagonal model, it is assumed that the updated R,G,B are Rn,Gn,Bn:

$$\begin{bmatrix} Rn \\ Gn \\ Bn \end{bmatrix} = \begin{bmatrix} Xr & 0 & 0 \\ 0 & Xg & 0 \\ 0 & 0 & Xb \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (5)$$

$$Rn = Xr*R \quad (6)$$

$$Gn= Xg*G \quad (7)$$

$$Bn= Xb*B \quad (8)$$

2.4 The color difference detection

In order to detect the chromatic aberration in the image more accurately, the original image is converted to Y Cb C r space, which has a similar constitution principle to human visual perception process, and the brightness information is separated from the chroma information, which is less affected by the brightness change and is widely applied in various fields. The transformation relation of mapping from RGB space to Y Cb Cr space is as follows:

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0.2990 & 0.5870 & 0.1440 \\ -0.1687 & -0.3313 & 0.5000 \\ 0.5000 & -0.4187 & -0.0813 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (9)$$

Blue-green difference and red-green difference (Cb and Cr), white difference is 0, where Y represents the brightness of the image (luma).

Nakano proposed the following constraint conditions according to the characteristics of white equilibrium:

$$\begin{cases} Y > X \\ -a < Cb < a \\ -b < Cr < b \end{cases} \quad (10)$$

The pixels within the constraint area are considered white, while the pixels outside are considered non-white. The average chromatic aberration of white pixels is calculated to replace the chromatic aberration of the whole image, thus improving the accuracy of color temperature estimation and reducing the complexity.

3. Hardware Architecture Design

The following hardware architecture is designed to implement and verify the white balance algorithm.

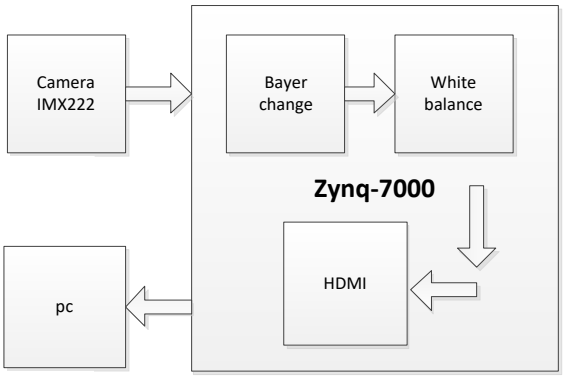

Figure1. Hardware system architecture

 DOI: https://doi.org/10.26549/met.v3i2.3080

As shown in the figure, firstly, SONY's IMX222 camera is used to collect image data and pass the data to Bayer module for image conversion, and then the image data is passed to the core white balance module for white balance calculation. Then through the HDMI conversion module after the image conversion output display.

3.1 Bayer Change Module

Since the image data output by Camera IMX222 is in Bayer image format, white balance calculation cannot be performed directly. Therefore, we need to convert Bayer image format to RGB image format before calculating white balance. Bayer is the original image format inside the camera, commonly suffixed.raw. Our cameras take pictures and store them on a memory card in.jpeg or whatever format, and they're converted from.raw. As shown in the figure below, the bayer color filter array is composed of half G, 1/4 R and 1/4 B.

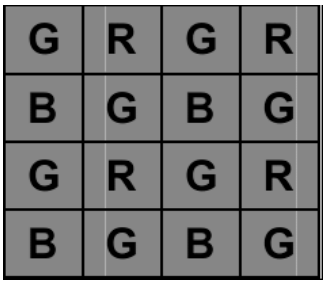

Figure 2 Bayer color filter array

Each pixel contains only a portion of the spectrum and must be interpolated to achieve the RGB value for each pixel. To get the RGB format for each pixel from the Bayer format, we need to fill in the missing two colors by interpolation. There are many interpolation methods (including domain, linearity, 3*3, etc.), speed and quality tradeoff, this paper chooses the 3*3 matrix method.

3.2 White Balance Module

In this module, the use of grayscale world algorithm will lead to division in the calculation of white balance algorithm. In ZYNQ, although there is a dedicated division IP, it will consume a lot of resources. Therefore, the method of using displacement instead of division proposed in this paper will greatly save resources. The images collected by the camera IMX222 in this system are 1080*1920. Therefore,

the total number of bits processed is:

$$Z=(1080*1920)_{10}$$
$$=(1FA400)_{16}=(11111010010000000000)_{2} \quad (11)$$

Make an approximation here:

$$Znew=(200000)_{16} \quad (12)$$

Then the approximate error:

$$W=(Znew-Z)/Z=1.13\% \quad (13)$$

Therefore, the sum and low 21 in the white balance algorithm can be removed and the high value can be retained, which greatly reduces the complexity of the algorithm implementation under the condition of low error.

4. Test Results Presentation

The field test of the system shows that the IMX222 camera can collect image data smoothly, the algorithm can run in the system perfectly for a long time, and the white balance correction of the image can be realized. As shown in Figure 3 and Figure 4 below, figure 3 is the unprocessed picture and figure 4 is the picture processed by the system.

Figure 3. Unprocessed image

Figure 4. Processed image

5. Conclusion

In this paper, aiming at the characteristics of high complexity of automatic white balance algorithm and poor real-time performance of hardware implementation, the advantages of grayscale world model and white point detection algorithm are integrated. On ZYNQ-7000, the white balance algorithm is realized by using the powerful computing power and design platform of ZYNQ. Moreover, the approximate advantages of some algorithms are used to simplify the consumption of hardware resources and improve the efficiency and timeliness of the algorithm. After testing, the whole system can run smoothly on ZYNQ-7000 and realize accurate correction of off-col-

DOI: https://doi.org/10.26549/met.v3i2.3080

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 DOI: https://doi.org/10.26549/met.v3i2.3080

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REVIEW

The Key Technologies and Influence Factors of the Information Platform Construction for Material Quality Management in Urban Subway Project

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ARTICLE INFO

Article history
Received: 9 May 2019
Revised: 10 June 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
Subway project
Information platform for material quality management
Key technologies
Influence factors

ABSTRACT

A number of factors may affect the quality of subway project during construction such as construction material and construction personnel. Therefore, it is necessary to study about the influence factors of subway project quality. A variety of influence factors can be analyzed and studied through the information platform for material quality management in urban subway project to further ensure the quality of subway project. This paper mainly summarized the significance of the information platform for material quality management in urban subway project, investigated the construction scheme of the information platform for material quality management in urban subway project and analyzed the key technologies and influence factors for information platform construction.

1. The Significance of the Information Platform Construction for Material Quality Management in Urban Subway Project

As urbanization continuously accelerates, the subway project has developed rapidly. In subway construction, material is an indispensible and crucial element, whose quality will directly affect the overall quality of subway project. Therefore, to effectively manage material quality is of great importance. With the development of information technology and network technology, every industry is undertaking information reform and development. The information construction for material quality management in urban subway project has

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Fund Project:
The paper is sponsored by the Science and Technology Plan Center of National Market Regulatory Administration Bureau (Project No.: 2017QK192).

DOI: https://doi.org/10.26549/met.v3i2.1644

become an important way to promote project construction and stimulate the development of construction industry. Subway project is one of the above projects. The information platform construction of material quality management in urban subway project to manage the quality of a variety of materials is of great significance in accelerating subway construction, reducing construction costs and ensuring project quality.

2. The Construction Scheme of the Information Platform for Material Quality Management in Urban Subway Project

2.1 The Integration of "Standardization, Systematization and Intelligence" for the Information Platform of Material Quality Management in Urban Subway Project

The standardized, systematic and intelligent construction should be actively implemented in the information platform of material quality management in urban subway project. Standardization, Systematization and Intelligence should be effectively integrated to give full play to the underlying efficiency of the information platform.

2.1.1 Standardization

To ensure effective information platform for quality management and reliable information sharing, this platform should be standardized. The standardization can mainly be demonstrated in the following aspects: Firstly, unified element codes and standardized management; secondly, core elements for subway project including construction personnel, material and equipment should be archived to further ensure standardized management for archival data; thirdly, the standardization inspection should be conducted for each item in subway project and standardized inspection frequency should be guaranteed to give full play to the role of inspection; fourthly, onsite sampling and evidence acquisition should be implemented in subway project to ensure the quality of subway project, therefore, sampling and evidence acquisition should be standardized to provide effective evidences for subway project quality; lastly, inspection procedure should be standardized. The standardized inspection procedure can ensure effective inspection results to some extent to further promote the progress of subway construction [1].

2.1.2 Systemization

Normally, construction project is featured in long cycle, large investment and massive contents. The construction should be systemized and methodized during the entire process. Therefore, the information platform for material quality management in subway project should also be systemized during construction. The systemization can mainly be illustrated in the following aspects: The first is systematic and automatically closed-loop management for the entire quality inspection process, which starts from the registration of personnel, materials and equipment. The basic materials and daily quality inspection records should be archived. The defective products should be effectively controlled and summarized. The systematic management is a way to sort and summarize information and data about subway project for future query and use. The second is to traceable management for personnel, materials and equipment. Take equipment for example, equipment management includes real-time tracking and records-making about procurement, transport, construction and utilization to further understand the status of the equipment [2].

2.1.3 Intelligence

Intelligence is what modern construction project pursues, and it is the same case with subway project. Therefore, this information platform should also be intelligent to further ensure the quality and safety of subway construction. The intelligence can mainly be interpreted in the following aspects: The first is dynamic analysis on quality issues to timely detect and analyze issues. The second is to intelligent alarms on quality risks, which is to predict potential quality risks and establish alarm mechanism to automatically provide alarms for risky areas, thus to reduce quality risk factors and the impact caused by risks to some extent. The third is intelligent decision-making by pilot, which is to effectively monitor each item of subway project and make intelligent decisions, thus to ensure the accuracy of decisions [3].

2.2 Four Core Elements in Platform Management

The quality supervision platform for subway project is an important part of the information platform for material quality management in subway project, which mainly includes four core elements: construction personnel, construction material and construction equipment as well as construction scheme. Specifically, Construction Personnel, personnel's basic information, qualifications, certificates, appraisal and credits are mainly recorded in the quality supervision platform for future query and use. Construction Material, it is well known that construction material costs account for more than half of the total construction cost. So it is quite necessary to effectively supervise and monitor construction materials. The quality inspections on raw materials and components, semi-finished and finished products as well as concrete are mainly included in this platform. Construction Equipment, it is an important physical foundation of subway project. The equipment

 DOI: https://doi.org/10.26549/met.v3i2.1644

quality directly affects the progress and quality of subway construction. Therefore, equipment files, acceptance, inspection and maintenance, hazard rectification and abnormal warnings should be included in this platform to ensure the normal working conditions of the equipment. Construction Scheme; it is a guideline for subway construction, which determines the construction procedure and technology during the project. The review and approval for inspection reports and instructions as well as the supervisions for project review records and construction process should be included in this platform to further ensure the overall quality of subway project [4].

2.3 The Objectives of Information Platform Construction

The information platform construction mainly includes four objectives, which are code unification, process supervision, and abnormal warnings as well as data analysis. Specifically, Code Unification refers to the unified codes for personnel, materials, equipment and documents in accordance with agreed norms on the information platform to lay a solid foundation for standardized business operation and management. Process Supervision refers to specific process supervision and management for personnel, materials, equipment and construction scheme on this information platform, which includes qualification review, trainings and appraisals as well as audit management for personnel, onsite inspection management for materials, archival, daily inspection, repair and maintenance for equipment and archival, scheme assessment and process supervision management for construction, to finally realize the closed-loop management for the overall construction process. Abnormal warnings refer to the management for specific assessment indexes and business processes to actively provide warnings about abnormal business (overdue or defective) on this information platform to further timely remind users and effectively avoid risks. Data Analysis refers to data statistics about personnel, materials, equipment, agencies, time and schemes on this information platform to provide data support for leaders' business decision-making [5].

3. The Construction Process and Key Technologies of the Information Platform for Material Quality Management in Urban Subway Project

3.1 Platform Construction

Four aspects should be taken into account in the initial periods during platform construction, which are talents management, hardware facility procurement, system development and maintenance as well as information collection and processing. The specific details are as follows:

3.1.1 Talents Construction

Talents play a crucial role in the information platform construction including platform development, operation and maintenance. Specifically, government affairs application departments should be responsible for developing the platform, mainly including planning and designing the information platform for subway materials as well as application technology and services. The technical department should be responsible for platform operation, mainly updating materials and prices in the information platform for subway materials. The system operation department should be responsible for platform maintenance, which mainly includes the planning, construction, operation, maintenance of network platform as well as the operation and maintenance of portal websites and system platform. These jobs require talents with excellent professional competence and strong comprehensive quality as well as cooperation among different departments to lay a solid foundation for the information platform construction for subway materials.

3.1.2 Hardware Facility

The hardware facility construction is an important content for the information platform construction. We should follow the principles of high technology, high standard and high starting-point during actual construction. Hardware facility mainly refers to network hardware, mainly including network server, work station, router, repeater and interchanger as well as office desktop for each individual.

3.1.3 Application System Construction

The application system construction mainly consists of two parts: database selection and workbench. Database mainly includes storage database and analysis database, whose functions are data storage and online data statistics and analysis, query and mining respectively. The workbench mainly consists of business to be supported by the platform, which is the business scope of materials to be provided by the information platform of subway materials to further provide evidence for subway construction.

3.1.4 Data Collection and Processing

Data collection and processing mainly includes information collection, analytical statistics and professional service. Specifically, information collection is to collect, analyze and sort out the information about subway materials. Analytical statistics is to the function of providing information statistics, query and analysis. Professional service mainly refers to the basic service associated with

DOI: https://doi.org/10.26549/met.v3i2.1644

material information like function-based access, mails and messages.

3.2 The Key Technologies s of the Information Platform Construction for Subway Materials

3.2.1 Digital Technology

With the continuous progress of science and technology, digital technology develops rapidly, which has been widely used in a variety of fields. Digital technology is a basic technology for the information platform construction of material management in subway project. This technology is the driving force of today's computer technology. Digital technology is to translate a variety of information with the help of equipment into the digits that can be identified by computer for further digital processing, transport and storage. As information processing includes encoding, compression and decoding by computer during calculation and storage, so it is also called as computer digital technology. The digital technology has been applied in the information platform construction of material management in subway project for digital processing against material information and translating the real information like model, material and price into a variety of information on the information platform for future query. Meanwhile, this technology also plays an important role in information input and exchange [6].

3.2.2 Cloud Computing Technology

Currently, cloud computing technology is a hot information technology, which has the advantages of strong reliability, high security and excellent flexibility. Therefore, it has a broad prospect for development. Cloud storage technology and cloud computing technology have been widely used in information resource sharing. It is the same case in the information platform construction of subway material management. The application of the technology has tremendously reduced the hardware demands for computer equipment based on virtual cloud while improving the utilization efficiency of existing computer. Besides, efficient cloud computing and accurate calculation will enhance the operation efficiency of the information platform and reduce construction costs.

3.2.3 Internet of Things Technology

The Internet of Things Technology is a derivative of the Internet growing from the Internet, which is characterized by widespread contents and massive functions. The key technologies for the Internet of Things Technology include sensor technology, RFID technology and embedded system technology. Specifically, sensor technology is to translate simulated signals and digital signals through computer for effective information storage. RFID technology refers to automatic identification and management for data and information, through which material data can be effectively identified and managed automatically. Embedded system technology refers to the rapid processing of the information after it is received[7]. The application of the Internet of Things Technology has made the information platform for material management in subway project more delicate and intelligent, thus giving full play to the real functions and improving the service capacity of the platform.

4. How to Improve the Management of the Information Platform for Material Quality Management in Urban Subway Project

4.1 Technical Equipment

Technical equipment is a basis for the information platform construction. In the era of the continuous social and technological development, an increasing number of new materials, new technology and new equipment are making their presence. Therefore, it is quite important to focus on the update and upgrade about technical equipment during the information platform construction. Computer is one of the important equipment for the information platform construction, so it is really important to timely update the hardware and software system of computer so that its functions and performances can be enhanced to constantly promote the modern and intelligent construction of the platform and provide better support for supervision and management[8]. Meanwhile, it is necessary to introduce advanced technologies like big data to further improve the management efficiency for material quality information and provide specific information for users.

4.2 Personnel

In addition to technical equipment, it is also important to constantly improve personnel's comprehensive quality so as to give full play to the real role of information platform. As main body for the information platform for material management in subway project, personnel's professional competence and business quality directly affects the construction of the information platform. With the development of information and technology, it is necessary for personnel to master certain techniques and skills to so as to make full use of the information platform, give full play to the real function of the information platform, ensure the quality of subway project materials and promote the progress of urban subway project. Besides, it is also important for platform maintenance personnel to have certain techniques and professional quality. When some is-

 DOI: https://doi.org/10.26549/met.v3i2.1644

sues or loopholes occur on the platform, they must be able to effectively settle issues and fix up loopholes to further ensure the normal operation of the information platform for material management in subway project.

5. Conclusion

In summary, targeted at code unification, process supervision, abnormal warnings and data analysis, the information platform for material management in urban subway project is a platform based on digital technology, cloud computing technology and database technology. It is necessary to focus on improving personnel's skills and abilities, updating technique and equipment as well as data compatibility and sharing so that the platform can run more efficiently.

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DOI: https://doi.org/10.26549/met.v3i2.1644

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Modern Electronic Technology
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REVIEW

Research on Internet Public Opinion and Social Governance in the Big Data Era

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ARTICLE INFO

Article history
Received: 9 August 2019
Revised: 25 August 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
Big data era
Internet public opinion
Social governance

ABSTRACT

In the development of modern society, the Internet public opinion presents the characteristics of cross-platform, multi-node, complex, etc. There are quite a few types of online public opinion with short duration, and the content has certain conflicts. The network opinion has greatly changed in the development of society, but there are still many pressures of public opinion. The paper studies the Internet public opinion and social governance in the big data era, and hopes to realize the scientificity of social governance.

1. Introduction

In the rapid development of social economy, Internet technology has been widely used in various fields, and the masses can express their own public interest needs on the Internet, which makes the public opinion in the social media platform gather, collide and erupt. In the Internet era, WeChat is a representative of social media platform. The functions of official account, group chat, friend circle, etc. play a crucial role in the process of generating Internet public opinion, and Weibo is important in the spread of emergencies [1]. Therefore, in the environment of big data, the social media platform has generated Internet public opinion, and government departments should strengthen social governance.

2. Overview of Internet Public Opinion and Network Social Governance

Internet public opinion refers to social conditions and public opinions in the social network platform, which mainly involves two aspects, namely: Firstly, using the Internet to publish and disseminate news events and hotspot information; Secondly, the viewpoints, attitudes and opinions expressed by the masses. At this stage, the Internet and social network have been widely used in the development of society, and the dissemination speed of news information has been greatly improved. However, many emerging online media are featured with low requirements, large user base, large amount of information, real-time, etc. Everyone can produce and spread news [2]. Network social factors mainly include network information, network be-

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 DOI: https://doi.org/10.26549/met.v3i2.2237

havior and social relations, and other information. Moreover, Internet public opinion reflects the viewpoints and contradictions in the network society. In the big data era, China has formed a large and complex network society, which involves quite a lot contents, such as information dissemination, social interaction, economic and social development, social management and so on. Internet public opinion governance refers to monitoring and managing social opinion information in network communication, while network social governance refers to adjusting network information, network behavior governance, social relations, etc., and fully exerting the role of network information dissemination platform.[1]

3. The Characteristics and Value of Big Data

3.1 The Characteristics of Big Data

At present, there is no clear definition of big data in the academic world. A large number of people think that the characteristics of big data are mainly reflected in the following aspects: Firstly, needing a lot of data; secondly, utilizing data sources stored in the related structures; thirdly, updating and analyzing the data in time. In the development of modern society, the total amount of data refers to an exponential increase trend. The integration of many unstructured data makes the data complex, which greatly improves the speed of data generation, analysis and processing.

3.2 The Value of Big Data

The value of big data is mainly to effectively filter and abstract related data, and use visual technology to present these data. The amount of data is relatively large, which lowers the value and density of big data, but big data has a strong value-added effect [3]. Big data analysis, involving many fields, can predict and analyze according to data trends and patterns. Therefore, big data analysis not only stays on the surface, but also needs to analyze various data in depth and fully exploit the potential value of the data.

4. The Characteristics of Internet Public Opinion in the Big Data Era

4.1 Diversification of Internet Public Opinion

Traditional Internet public opinion mainly refers to public affairs and public issues, while public issues refer to social problems corresponding to individual problems, which greatly affect the daily life of the masses and the development of social economy. In the development of the Internet era, Internet public opinion includes not only social problems related to the common interests of the masses, but also problems in the field of consciousness such as social thoughts and moral ideas. Through relevant research, it is found that the types of Internet public opinion hotspots mainly include social contradictions, public management, public security and anti-corruption, as well as sports and entertainment, public figures and military diplomacy. In addition, Internet public opinion involves social ethics, labor disputes, ideological disputes and other social contradictions, and all sectors of society should pay attention to the social impact of public opinion.[2]

4.2 Internet Public Opinion with Short Duration

In the development of social economy, Internet technology has been widely used in the masses' daily life. It is real-time and interactive, providing the masses with diverse information so that everyone can make reasonable choices and discuss issues according to the actual situation. However, in the context of the increasing hot public opinion events in social public affairs, the duration of individual hot issue has become shorter and shorter, and there is less than a week from outbreak to fade of the public opinion. The masses have a relatively low degree of concentration on the subjects of little change, but mixed with new topics and elements, the subjects will be able to inspire everyone's interest. Under the background of the increasing network hotspots, the people concentrate on the new hot events, but no longer pay attention to the continuity of a single event. Internet public opinion reflects the emotions of the masses, but it is characterized by instability. The opinions of the masses will continue to change during the development of the incident. Many public issues cannot fully reflect Internet public opinion, and the people can express their opinions and attitudes toward public issues, but their demands are greatly different, which leads to a certain conflict in the public opinion collected in the network.

4.3 Online Opinion Leaders Continue to Change

In the rapid development of social media, the influence of opinion leaders in social media is getting stronger and stronger. The information and comments published by online opinion leaders have been widely concerned by netizens, which has led to the exponent spread of social networks and developed into the masses' common concerns, further developing the events and topics into public issues [4]. At the same time, opinion leaders in social media platforms play the role of information transmitters and gatekeepers. In the process of second information dissemination, opinion leaders often add their own opinions

DOI: https://doi.org/10.26549/met.v3i2.2237

to discuss social issues in social media platforms, attracting more people to be concerned about social events. In addition, in the rapid development of the social economy, the Internet has been effectively applied in various fields of society, and network opinion leaders are changing day by day, but the influence of online opinion leaders on the setting of public issues still exists. Under the background of the increasing popularity of WeChat social media platform, government departments are paying more and more attention to online rumor governance, which makes "influencer" of Weibo replaced by private, civilian and automated dissemination of We-Media official accounts of WeChat. We Media has been given a new voice of the public opinion field.[3]

4.4 Traditional Media Lay Out and New Media Platform Promotes Internet Public Opinion

In the big data era, the ability of traditional media to set agendas in the social media era is steadily weakening, and public events in social media platforms have received widespread attention from all sectors of society, which still rely on traditional media reporting and promoting public events, and erupting in social media platforms. The social media platforms are generally used by traditional media to spread information such as facts, opinions and positions through Weibo account and WeChat official account. In the development of the new era, many traditional media in China have actively deployed new media content platforms such as WeChat and client, using the carriers of text, pictures, sound and video to implement the spread form of "mobilization", "fragmentation" and "matrix", which is conducive to ease public opinion.[4,5]

5. New Challenges Faced by Internet Public Opinion and Network Social Governance in the Big Data Era

5.1 The Government Uses the Network Platform to Become the Leader of Information Release

In the big data era, the development of social network media platforms is very rapid. The government has changed the identity of the only publisher of information and data. The business sector, social platforms and the masses upload large amounts of data, and relevant fields collect and mine large amounts of data and analyze them, publish platforms and provide consulting services. The conclusions have similar characteristics in this process, but there are certain differences in the data collection channels, making the statistical data methods different. And the data conclusions and government statistics will be different, which, to a large extent, threatens the authority of the government [5]. In addition, big data is characterized by noise and low density. In order to better protect the necessary confidentiality and enable the masses to have the right to know about data resources, government departments need to resolve the problems that there is limited authority of information resources and that the people are curious, which has gradually developed into a problem of strengthening Internet public opinion management in the process of social governance.

5.2 Internet Public Opinion Monitoring is Difficult

In the development of modern society, online news has gradually become an important channel for news dissemination, and has presented many new features, which has brought difficulties to Internet public opinion monitoring. Firstly, there are many online news dissemination platforms and the main body of dissemination is popular. Communication tools such as BBS, QQ, Weibo and WeChat have become important tools for the masses to acquire and disseminate information. The people can forward, load and comment on news with only a few keystrokes, which has greatly expanded the spread range of news and increased the speed of news dissemination; secondly, under the background of rapid improvement of imaging technology level, the communication content presents diverse characteristics. At this stage, the functions of video equipment and mobile phones are getting stronger and stronger, and the masses can get the latest news pictures and images conveniently. The form of online news dissemination is also increasing, including not only text and illustrations, but also high-definition videos and pictures, which has left a deeper impression on the masses and made the news more convincing; finally, with the rapid development of search engines, information acquisition is more convenient and presents the characteristic of initiative. Search engines integrate with language recognition and artificial intelligence technology by using big data, cloud computing, etc., and quickly search for more information using language and pictures, enabling the masses to actively accept information and search and comment on relevant information accurately and quickly.

5.3 Internet Public Opinion Analysis and Response are Increasingly Difficult

In the development of the new era, the government departments face great challenges. They need to grasp the dynamics of Internet public opinion in an accurate, comprehensive and timely manner, improve the ability

 DOI: https://doi.org/10.26549/met.v3i2.2237

of public opinion information monitoring and analysis, and provide support for public opinion. In addition, the response method of network public opinion can't meet the relevant requirements. In the traditional Internet public opinion response process, many government departments block information by deleting and forbidding posts. In the big data era, information is not transmitted to various websites and passively waits for browsing, but is spread rapidly to many network platforms in people's phones, making it easier to delete websites and information. In addition, the spread of online news is relatively wide and the speed is very fast, which brings difficulties to information blocking, making the government departments face great challenges in response speed and way.[6]

6. Optimization Measures of Internet Public Opinion and Social Governance in the Big Data Era

6.1 Correctly Understanding the Negative Effects of Internet Public Opinion

In the big data era, social media has developed very rapidly, providing an open and equal environment for the masses to express their social and political attitudes, but it has gradually developed into a way to create rumors. In the context of social media, the problem of group polarization is becoming more and more serious. For example, a lot of information cannot enter the closed social environment such as WeChat friend circle and WeChat group chat. Radical and conservative attitudes will affect the group's tendency, which seriously inhibits public opinion and has an impact on the social governance of government departments [6]. Therefore, social media has broadened the sources and ways of public opinion to a certain extent, but relevant personnel need to recognize the negative effects of Internet public opinion in the social media environment, and implement collection methods such as Internet public opinion collection, citizen surveys, and hearings to provide everyone with more opportunities for expression of needs and interests.

6.2 Improving the Credibility of Government Information Dissemination

In the process of governing the Internet public opinion, in the context of the close attention of the masses, influenced by the Internet communication, there have been many rumors that seriously affect the development of the country and society. Therefore, in order to correctly guide Internet public opinion, relevant departments need to establish transparent channels for information disclosure, timely release comprehensive, accurate and effective information, and solve the doubts of the masses. At this stage, many government departments have established government website and Weibo, but there are still a series of problems. For example, after the establishment of the government website and Weibo, the public's trust was lost because the information was not updated in time and the masses' doubts were not promptly reported. Therefore, the government website and Weibo platform need to update and release information related to the production and life of the masses in time, and answer the public's questions in a timely manner. In particular, the development potential of Weibo and WeChat platforms is relatively large, and government departments need to improve their administrative efficiency, integrate the network platforms of various regions and enhance the public's trust of government information through the release of information and interaction.

6.3 Building a Government Internet Public Opinion Monitoring System

In the process of Internet public opinion monitoring, information technology brings certain opportunities and challenges[7]. At this stage, the monitoring of Internet public opinion by the government departments is mainly on the security, which requires the construction of an effective government Internet public opinion monitoring system to fully play the role of this system: First, using the Internet to understand social conditions and public opinions, and obtaining and analyzing more real public appeals; Second, timely understanding and collecting public opinions related to the government departments and track them; Third, mastering the process, changes, and future development of emergencies and public opinions, and providing convenience for the government to reasonably choose intervention time and measures; Fourth, stopping and punishing timely illegal acts to avoid the spread and uncontrol of illegal public opinions; Fifth, government departments need to improve relevant policies and measures in time, rationally adjust social relations, and provide support for the smooth development of government decision-making. In addition, the government Internet public opinion monitoring system can construct by using e-government private network, terminal storage and service equipment with the help of the storage and computing functions in the cloud platform, and use relevant procedures to provide information collection, processing analysis, public opinion management and other services for the government. In the process of constructing the government Internet public opinion monitoring system, relevant personnel need to take the provincial administrative division as the basis, set up in the city and county level by level, establish an Internet public opinion data center,

DOI: https://doi.org/10.26549/met.v3i2.2237

and improve the comprehensive and real-time nature of the Internet public opinion monitoring.

7. Conclusion

In summary, in the big data era, Internet public opinion, as a network public opinion, has greatly affected government management[8]. Internet public opinion is characterized by many types of issues, short duration breaks, content conflicts, etc., but there is a great public opinion impact. Traditional media also use new media platforms to promote the development of public opinions, which requires relevant departments to strengthen their understanding of characteristics of Internet public opinion in the big data era, and use big data technology to guide the public opinion of traditional media, laying a foundation for government departments to conduct social governance.

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 DOI: https://doi.org/10.26549/met.v3i2.2237

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REVIEW

Design and Implementation of Data Management System for Lightning Protection Inspection Based on Android

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ARTICLE INFO

Article history
Received: 9 August 2019
Revised: 25 August 2019
Accepted: 10 October 2019
Published Online: 16 October 2019

Keywords:
Safety inspection for lightning protection devices
Mobile applications
Professional equipment
Information management

ABSTRACT

In order to ensure the safety of buildings, equipment, personnel, property and production, to prevent or mitigate the disasters caused by lightning and static electricity, and to avoid the occurrence of serious lightning accidents, lightning protection inspection (acceptance) is of great significance. At present, in the process of inspection (acceptance) of lightning protection devices, there are following problems: professional and technical equipment for inspection is various and with different performances; the market demand for lightning-proof safety inspection is large, and entrusted units are increasing; the inspection process is difficult to be accurately obtained anytime and anywhere. Therefore, it is proposed to adopt technology of mobile application, wireless network transmission and computer software development to design and develop a data management system for lightning protection inspection based on Android, so as to realize the functions like real-time and comprehensive information management of professional lightning-proof inspection devices and entrusted units and establishment of electronic files for lightning-proof inspection of all projects.

1. Preface

Lightning is "one of the ten most serious natural disasters" that affect human life, and is also "a public hazard in the electronic age"[1]. Lightning disasters occur frequently in our country, as a result of which the casualties and economic losses are on the rise year by year, and the social impact is also increasing rapidly [2]. With the continuous and in-depth development of lightning-related disasters prevention work, local meteorological departments are attaching more importance to the information construction work of lightning prevention and disaster reduction management departments [3], and are also developing software systems out of their own business needs. However, most of the systems are limited to the business management within the office and do not have the ability to process the safety inspection data of lightning-proof devices anytime and anywhere [4], moreover, the business functions realized by the software are too single to grasp the accuracy of information from the information sources of lightning-proof devices.

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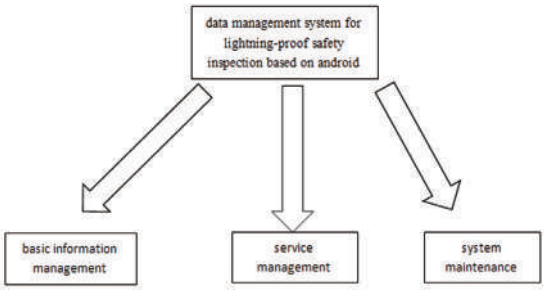
DOI: https://doi.org/10.26549/met.v3i2.3407

2. Research Content and Technical Routes of Systems

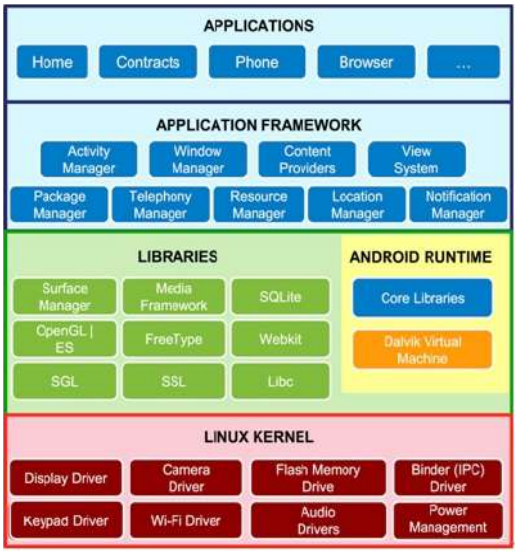
2.1 Research Content

Using hand-held terminal systems and wireless channels to assist staff working on lightning-proof devices safety inspection to use wireless terminals at anytime and anywhere: to establish electronic files of professional lightning-proof inspection devices and realize functions such as inquiry and editing; to establish the electronic files of entrusted units and realize the functions of inquiry and editing; to establish the electronic files of lightning prevention and inspection business for all projects and realize the functions of inquiry and editing. The framework of system functions is shown as below:



2.2 Technical Routes

Android is a kind of operating system based on the freedom of Linux and open source code, which is mainly used in mobile devices like smart phones and tablets, and it is led and developed by Google and Open Handset Alliance [5]. Android's Linux kernel control includes Security, Memory Management, Process Management, Network Stack, and Driver Model, etc. [6]. The technology architecture of Android [7] is shown as following figure:

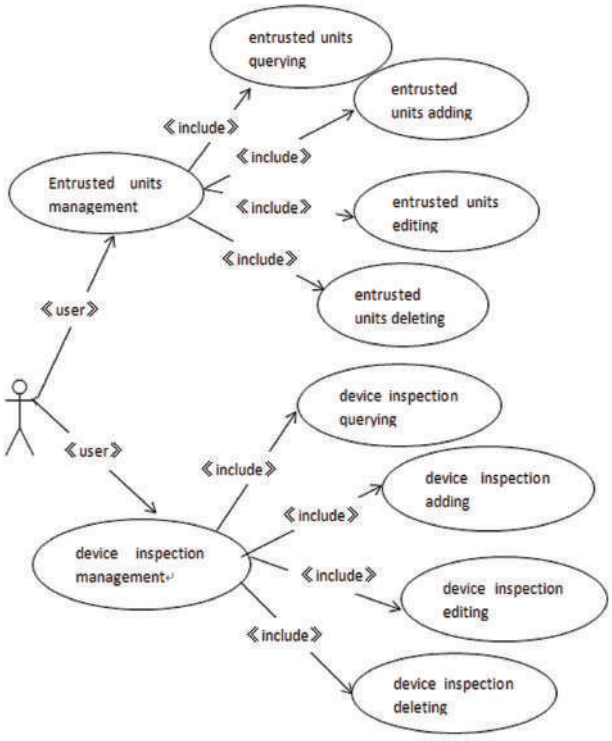


3. Implementation and Application of Key System Functions

In the functional analysis, the basic information management service, business management service and system maintenance and management service will be designed using UML modeling language, and the use case diagram of the service and the use case specification table of the core service will be given. Android-based data management system for lightning-proof safety inspection can operate the analysis function at the mobile phone end. The users with operation authority in this system are data processing personnel working on lightning-proof safety inspection.

3.1 Management and Analysis of Entrusted Units of Lightning Prevention Testing and Technical Equipment

Lightning prevention data processing personnel can query, add, edit and delete the information of the entrusted units, and can also carry out similar operations on the information of professional lightning-proof equipment. Use case diagram of basic information management service is shown as following figure:



(1) Entrusted units management: Operations such as Entrusted Units Query, Entrusted Units Add, Entrusted Units Edit and Entrusted Units Delete can be performed. When querying the information of the entrust-

 DOI: https://doi.org/10.26549/met.v3i2.3407

ed units, the company information needs to be retrieved according to the company name and contact person, after which the contact phone number, zip code, and address can be retrieved.

(2) Management of lightning-proof inspection technology and equipment: Operations like querying, adding, editing and deleting lightning-proof inspection technology and equipment can be carried out. Information such as instrument name, model and number shall be filled in when adding lightning-proof inspection technology and equipment. After executing deleting operation, the inspection information will disappear in the database.

3.2 Business Management Analysis of Lightning Protection Testing

The functions analyzed in business management include the management before, in and after lightning protection testing.

(1) Management before lightning protection testing: operations such as detection, details query, addition, editing and deletion of lightning protection before testing could be carried out. It is necessary to record the entrusting unit, unit address, zip code, lightning protection category, contact person, contact phone number and entrustment agreement number when starting the operation.

Use case name	Lightning Protection Management to Be Detected	Use case number	SafetyInspectionUT-02
Participating member	Lightning protection data processor		
Use case analysis function	Detection, inquiry, and editing of lightning protection before being tested		
Preconditions	(1) The functions of the original data acquisition and processing system for the safety detection of lightning protection devices based on mobile applications can be executed normally. (2) The lightning protection data processing personnel log into the original data acquisition and processing system of lightning protection device safety detection based on mobile application.		
Basic event flow	(1) When lightning protection data processing personnel request for lightning protection to be detected, users need to query information according to the entrusting unit and the contact person, which includes the entrusting unit, contact person, unit address, contact telephone number, zip code, entrustment agreement number and testing status. (2) Lightning protection data processing personnel need to input information such as entrusting unit, contact person, unit address, contact phone number, etc. according to system prompts when requesting to the addition operation in lightning protection testing. After recording, user select save to complete. (3) When requesting the lightning protection detection editing operation, the lightning protection detection information shall be located according to the entrusting unit and the contact person firstly , and then the located lightning protection detection information shall be changed and saved after the change is completed.		
Abnormal	Data update speed is slow when editing lightning protection detection.		

The use case specification table of lightning protection management before testing is shown in the following table.

(2) Management in lightning protection testing: the operation of inquiring including inquiring details can be carried out. The entrusting unit, unit address, zip code, weather condition, lightning protection category, contact person, contact number, detection date, ground condition, entrustment agreement number, etc can be inquired in the details function in lightning protection testing.

(3) Lightning protection detected management: it can detected inquiry and lightning protection detected inquiry details.

(4) Lightning protection pending audit management: pending audit inquiry, pending audit inquiry details and pending audit printing operations can be carried out.

(5) Lightning protection detection management: new detection operations can be carried out.

3.3 Account Configuration and System Maintenance

(1) Account information maintenance: information inquiry, information addition, editing, deletion and password reset can be performed.

(2) Role management: Role query, addition, editing, deletion and empowerment can be performed. Different roles have different operation permissions. When editing role information, the name and comments of the role need to be changed. Before deleting a role, one should query the role first, find the role that needs to be deleted, and then perform the deletion operation.

(3) Resource management: resource query can be performed. Information in the resource management area includes resource name, URL, whether to display menu, menu type, sorting and so on.

4. Conclusion

Through the design and implementation of each functional module of the Android-based lightning protection safety detection data management system, real-time and comprehensive systematic management is realized for those specialized technical equipment with complex models and different performances and the large number of

DOI: https://doi.org/10.26549/met.v3i2.3407

lightning protection detection commissions. A specific lightning protection detection business process can be detected by users accurately at any time and anywhere, and users also can audit, add information, etc. This system reduces the waste of paper, improves the work efficiency of the detection personnel, and helps the lightning protection safety supervision department to check and repair defects, and thus avoiding the occurrence of lightning disasters and bring certain social benefits

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Contribution: Researchers A and B researched literature and conceived the study. Researcher A was involved in protocol development, gaining ethical approval, patient recruitment and data analysis. Researcher B wrote the first draft of the manuscript. All authors reviewed and edited the manuscript, and approved the final version of the manuscript.

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