DETERMINATION AND MONITORING OF COTTON YIELD CREATION OF AN AUTOMATED SURVEYING SYSTEM

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Annotatsiya. Ushbu maqolada paxta hosildorligini aniqlash uchun avtomatlashtirilgan vizual ranglarni aniqlash tizimi hamda ranglarni miqdoriy baholashga mo‘ljallangan intellektual dasturiy paketni ishlab chiqish va joriy etish masalalari muhokama qilinadi.

Kalit so‘zlar: ko‘rish tizimi, model, avtomatlashtirilgan tizim, logistika, intellektual, dasturiy paket, identifikatsiya, sezish, prognozlash.

Аннотация. В данной статье рассматриваются разработка и внедрение автоматизированной системы визуальной идентификации цвета и интеллектуального программного пакета количественной оценки цвета для определения урожайности хлопка.

Ключевые слова: система технического зрения, модель, автоматизированная система, логистика, интеллектуальный, программный пакет, идентификация, зондирование, прогнозирование.

Abstract. This article discusses the development and implementation of an automated visual color identification system and an intelligent color quantification software package for cotton yield determination.

Keywords: vision system, model, automated system, logistics, intellectual, software package, identification, sensing, forecasting.

INTRODUCTION

In order to ensure the implementation of the Resolution of the President of the Republic of Uzbekistan No. PQ-113 dated April 5, 2023 on measures to introduce advanced digital technologies into the agricultural sector, as well as to implement interdepartmental information systems for monitoring the condition of crops through the widespread introduction of advanced digital technologies into the agricultural sector, the following are being implemented:

a) a platform for providing services that analyze geoinformation technologies and space images will be introduced. In this regard, a system will be created to independently monitor the arable land and crops allocated to agricultural producers and clusters based on multispectral space image analysis, identify problems early and provide recommendations for increasing productivity;

b) the current mechanisms for placing agricultural crops will be improved using digital technologies. In this regard, the “CropAgro” information system will

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be introduced to accept proposals from land users, electronically place agricultural crops, coordinate, and automatically generate information and reports;

c) on the basis of the “Geoinformation System” of the Ministry of Agriculture, the agricultural geoportals of the Republic of Karakalpakstan and the regions will be improved, and local executive authorities will establish open access to geographical, statistical and analytical information on the agricultural sector of the relevant regions;

g) the organizational and legal form of the “Center for Digitalization of the Agro-Industry” state institution under the Ministry of Agriculture (hereinafter referred to as the “Digitalization Center”) will be changed to a limited liability company and, in accordance with the established procedure, will be transformed into a resident of the “IT-Park” as an integrator operating in the direction of digitalization in the agricultural sector.

RESEARCH METHODOLOGY

Taking into account the above, the aim of the article is to develop an intellectual software package (DISP) that accurately calculates the color and number of opened cotton bolls, identifies colors, i.e. determines the amount of colors. This allows for informed decisions in agriculture on the timing of harvest, forecast volumes and optimization of logistics. These methods (Figure 1) allow to increase the harvesting efficiency by up to 95% by minimizing human errors and increasing the accuracy of yield data. In addition, this method is implemented in the creation of an DISP package that monitors the state of cotton fields in real time, determines the yield, health (e.g., the need for irrigation, fertilization), pests and diseases, and covers the following problems (see Figure 1):

Development of a fast algorithm and mathematical models for identifying all color components in cotton field images.

To calculate the amount of "white" colors of cotton bolls, algorithms for identifying color images based on five search criteria are developed, and a functional scheme for accelerating image identification processes based on MapReduce technology is developed.

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Figure 1. Application of methods for determining productivity.

DISCUSSION AND RESULTS

The stages aimed at developing and implementing an intelligent software package for assessing cotton maturity (PACM) are as follows:

1. PASM uses automated machine vision methods and advanced mathematical algorithms to analyze images of cotton fields obtained from drones or mobile devices. It is an accurate calculation of the number of opened cotton bolls, which allows agricultural clusters to increase harvest time, forecast volumes and cotton harvesting efficiency by 95%.

2. Development of a fast algorithm and mathematical models for identifying all color components in the images of cotton fields, namely.

3. Approval of plans for conducting tests in cotton fields in Jizzakh and Syrdarya regions: algorithms and software for mathematical models will be created that will monitor the state of cotton fields in real time and determine the yield, health (for example, the need for irrigation, fertilization), pests and diseases:

4. Development of a fast algorithm and software for determining all color components in cotton field images and the amount of informative colors we need. Creation of the ability to obtain results in a tabular or graphical form for the amount of "white" colors of cotton bolls and development of algorithms for determining the amount of 5 search criteria, integration and creation of a software interface (SFI) for loading images, visualization of results and analytical accounting.

5. Development of a functional scheme for accelerating image identification processes based on MapReduce technology.

The tasks of preliminary processing of the color image of the cotton field obtained from the surveillance camera, its storage in the database (DB), filtering are performed. It is planned to compare the images in the DB with the data from the year to year and analyze the data, as well as to increase its

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efficiency and minimize the time spent on calculations and to create opportunities to increase efficiency indicators as a result of processing uninformative areas in the images.

It can be noted that this technology or method, based on the scientific principles of advanced countries, is considered as an automated system and is commercialized in cotton-growing farms and agricultural enterprises of the Republic of Uzbekistan. To implement these tasks, if we consider the area of the cotton fields as geometric colored figures, the data obtained through the DRON, the creation of control systems for the identification processes of the received data, important current directions for the development of the field of integration of information and communication technologies arise.

In the process of its development, science in the world is moving towards the study of more complex objects, as a result of an extensive analysis of sources, the following methods have emerged. Let's consider the traditional (classical) methods known to us:

Sample picking method. In this method, several control plots (for example, 1 m² or 10 m²) are selected from the field. The cotton in these plots is picked and its weight is measured. It is calculated based on the average value per hectare and the formula is as follows

$$H = (V \times 10\,000) / M$$

Here, H-yield (s/ha); V-sample weight; M –sample area.

Based on plant morphological indicators. In this method, the number of bolls in 1 boll is determined.Then, the weight of cotton in 1 boll is measured. Then, the boll density per 1 ha (number of bolls per 1 ha) is determined. As a result, the formula for this method is determined as follows

$$H = S*N*Mk$$

Here, H is the yield; S is the number of bunches in the bunch; N is the number of bunches; Mk is the weight of one bunch.

However, along with these opportunities, the introduction of artificial intelligence into the agricultural sector has the potential to solve a number of problems. This is an important direction of smart agriculture (Smart Agriculture), which uses drones, satellites, sensor data (IoT), and machine learning technologies. Let's consider 1 methods for determining the yield in cotton fields in agriculture:
When determining using a drone (UAV):

- Taking pictures with RGB and multispectral cameras.
- Cotton density and development zones are determined.
- A yield map is created.

The advantage of this method: very accurate and high precision.

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Measures are taken to determine the geometric changes of important parameters of video objects and to develop and store mathematical and geometric modeling of color properties. The use of parallel technologies in digital image processing plays an important role in solving the above problems. Therefore, an algorithm for calculating the process of obtaining “white” colors in a color image using Open MP technology has been developed. Images are defined by a two-dimensional function f(x, y), where x and y are in a certain space (or more precisely, in a plane), the value of f(x, y) at a coordinate point is called intensity or gray phase. In some publications it is called brightness. If x, y and f take discrete values, they are called digital images. Digital image processing is understood as the processing of digital images by computers. Any digital image is divided into elements limited in certain areas and take on fixed values. These elements are called image elements or pixels. The word pixel means picture element in English and is translated as an image element.

Images are defined by a two-dimensional function f(x, y), where x and y are in a given space (or more precisely, in a plane), the value of f(x, y) at a coordinate point is called intensity or grayscale. In some publications it is called brightness. If x, y and f take discrete values, they are called digital images. Digital image processing is understood as the processing of digital images by computers. Any digital image is divided into elements limited in certain areas and takes on fixed values. These elements are called picture elements or pixels. The word pixel means picture element in English and is translated as a picture element.

Color images. Each pixel of these images requires at least 2 bits. Each pixel has a 16-bit (65,536 colors) image called High Color, and each pixel has a 24-bit (16.7 million colors) image called True Color. Computer graphics systems also use images with 32, 44 or more bits per pixel. Types of data represented in the form of an image. When it comes to computer image processing, it is convenient to divide images into four groups:

1. Grayscale and color images.
2. Two- and multi-color images.
3. Double curves and straight lines.
4. Points or polygons.

A color image can be stored using three matrices (for red, green and blue) or one matrix that allocates certain bits for each color. It is known that if the difference in brightness is less than 1 percent, the human eye usually does not notice this. Therefore, when storing color images, it is enough to allocate one space for each color of the pixel. However, for best results, one byte of information is enough when storing each pixel of a color image in memory. In this case, 3 bits are

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allocated for each of the two colors and 2 bits for the third color. From a mathematical point of view, it is sometimes convenient to view a color image as a three-dimensional vector matrix. The input image is color. The algorithm consists of 4 steps.

Step 1 Convert the original image from RGB color model to YCrCb using the following formula (1):

$$\begin{aligned} Y &= 0.299*R+0.587*G+0.114B \\ Cr &= 0.5*R-0.4187*G-0.0813*B+128 \\ Cb &= -0.1687*R-0.3313*G+0.5*B+128 \end{aligned} \qquad (1)$$

Here, **Y** is the brightness of the original image, **Cr** is the difference between the R channel of the original image and the **Y** brightness, **Cb** is the **B** channel of the original image and the Y brightness.

Step 2. As a result of the experiments, the Cr channel ranges were determined, and the Cr channel represents the color change of human skin, that is, the selection of the C1 skin region in the image is calculated according to the following formula (2):

$$S_1 = \begin{cases} 1, \text{if } [\text{Cr}(x,y) \in [133;173] \cap \text{Cb}(x,y) \in [77;127]] \\ 0, \text{otherwise} \end{cases} \qquad (2)$$

Stage 3. In this stage, the task is to eliminate the noise generated by applying the actions of stage 1. Noise can be in the form of dots and small holes. To eliminate noise, we calculate the image density map according to the following formula (3): 3-bosqich.

$$D(x,y) = \sum_{i=0}^{3}\sum_{j=0}^{3} S_1(4x+i,4y+j) \qquad (3)$$

Points with zero density value (D(x,y)=0) do not belong to the face area. Points with full density value (D(x,y)=16) refer to the face area. Any point with an intermediate density value (0 < D(x,y) < 16) indicates the presence of noise.

The following operations are performed for the density map D(x,y):

• setting the values of all extreme points to zero – formula (4), i.e.

$$D(0,y)=D(x,0)=D(m,y)=D(x,n)=0 \qquad (4)$$

• set all points of the total density to zero if they are surrounded by less than five points of the total density;

• set all points of the density to 16 if there are more than two points of the total density near them.

The summation process at this stage consists of four cycles. That is, in two outer cycles, the calculation is performed on 362 × 468 = 168 416 pixels of the two-dimensional array obtained from the image. In two inner cycles, the calculation

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is performed on 4 × 4 = 16 pixels. This calculation process uses OpenMP technology for parallel calculation in parallel threads of the operating system. After these actions, the density map is converted into an image according to the following formula (6):

$$S_2 = \begin{cases} 1, \text{if } D(x,y) = 16 \\ 0, \text{otherwise} \end{cases} \quad (6)$$

Step 4. It is known that the face region in the image is heterogeneous, mainly compared to the background. Therefore, based on this feature, it is possible to more accurately determine the boundary between the background and the face area — formula (7). To do this, we calculate the standard deviation of each W aperture value in the 8 × 8 grid:

$$\delta(x,y) = \sqrt{E(W^2) - E(W)^2} \quad (7)$$

The speed of digital processing of matrix elements increases further when vectorization is performed in stages 3 and 4. The vectorization process consists of adding, subtracting, multiplying, or dividing N elements of the matrix at the same time. If the standard deviation is less than two, then the window in question is very uniform and is unlikely to be part of the face. This operation is applied to all apertures W — formula (8):

$$S_3(x,y) = \begin{cases} 1, \text{if } S_2(x,y) = 1 \text{ и } \delta(x,y) \geq 2 \\ 0, \text{otherwise} \end{cases} \quad (8)$$

As a result, we get an image containing a face area with minimal content or without noise. The time spent on serial and parallel calculations in the third and fourth stages of the algorithm is given in the table below.

Table 1.

Time spent on cleaning inactive features.

Number of images	Time spent on accounting		Speedup factor (С п (н))
	Sequential(sec.)	Parallel(sec.)	
1	0,00021	0,00017	1.235
5	0,00175	0,00125	1.400
10	0,248	0,119	2.084
20	1.152	0,391	2.946
40	2.354	0,727	3.238

According to the data in Table 1, it takes 0.00021 seconds for 1 image, 0.00017 seconds for parallelization, 1.152 seconds for 20 images, 0.391 seconds for parallelization, and 2.354 seconds for 40 images, 0.727 seconds for parallelization. The acceleration coefficient is calculated according to Formula 9:

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$$S_p(n) = \frac{T(n)}{T_p(n)} \qquad (9)$$

Bu yerda **T(n)**- ketma-ket dastur bajarilishiga sarflangan vaqt; **Tp(n)** — parallel dastur bajarilishiga sarflangan vaqt.

The time spent on extracting “white” color in color images can be significantly reduced using the proposed fast algorithm. If this process is used to solve identification problems in real time, it can provide information about the searched informative colors in a short time. The process of comparing the searched information with the N colors in the database with pre-processed information symbols allows the search system to automatically find suspicious informative colors. This method is used in surveillance and search systems, allowing for quick and efficient analysis of the searched color.

To understand how an automated vision system creates an image of the environment or objects, technical tools, mathematical models, and algorithms were studied to understand the issues related to the reception and digitization of light (light waves) reflected from a light source onto the surfaces of objects in the field of view. This includes the interaction of light rays with surfaces, their refraction and absorption, their passage through lenses, and the digitization of light on the camera sensor.

CONCLUSION

In conclusion, it can be said that the scientific significance of the research results is explained by the development of an algorithm and software package with a high calculation speed using the residual variance and correlation coefficient methods for identifying and recognizing the sought-after informative field in the video image. The proposed method, algorithm and its software package have been developed for identification and recognition in the automated recognition analyzer system, which is of practical importance. This technology helps farmers make the right decisions, reduces costs, waste and crop losses, and contributes to the goal of sustainable farming practices

REFERENCES:

1. Toshpu'latov D.Sh., Mamatkulov Q.E. Possibilities of using artificial intelligence technologies in agriculture// Science and education in acriculture. 2024, 2(2), p. 39-48.
2. Nabokov V.I., Nekrasov K.V., Zueva O.N., Donskova L.A. Industrial characteristics as a factor in the formation and development of logistics systems in the agro-industrial complex // Ural agricultural bulletin. 2016. Issue 12 (154).
3. Turapov U.U., Muldanov F.R. Analysis of criteria for image processing and recognition on the basis of informative and strong signs of personal face structure.

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// International conference AIR publishing. Cite as: AIP Conference Proceedings 2432, 060016 (2022); Published Online: 16 June 2022. Pp. 060016-1 060016-5. (#3; Scopus, IF=0.8).

4. Turopov U.U., Israilov U.B., Guliev A.A., Muldanov F.R. Non-Invasive Glucometer of Automatic Measurement of the Label in Blood. // International Journal of Engineering and Advanced Technology (IJEAT)/ISSN-2249-8958, Volume-9, Issue-3, February 2020. Pp. 3331-3336. (#5; Scopus, IF=0.75).

5. Turapov U.U. Muldanov F.R. Criteria, algorithms and software for creating a robotic eye analyzer. // Monograph. ISBN 978-9943-9585-1-7 Jizzakh sh. 2020 year. 118 p.

6. Turapov U.U. Muldanov F.R. Mathematical method and software for determining the geometric characteristics of a human face in a video image. // Monograph. ISBN 978-9943-9585-24 Jizzakh sh. 2022 year. 94 p.

7. Turapov U.U., Muldanov F.R. Analysis of criteria for image processing and recognition on the basis of informative and strong signs of personal face structure. // International conference AIR publishing. Cite as: AIP Conference Proceedings 2432, 060016 (2022); Published Online: 16 June 2022. Pp. 060016-1 060016-5. (#3; Scopus, IF=0.8).

8. Turapov U. U., Juraev G. U., Muldanov F. R., Guliev A. A. Problems of regulating the incoming and outgoing parameters of the object. // Scientific Journal of Mechanics and Technology. Scientific Journal of Mechanics and Technology. ISSN 2181-3760. 2022 #2 Special issue. Namangan-2022. 237-242 p. (Decision No. 311/6 of the Board of the OAK dated February 01, 2022).

9. Turapov U.U., Muldanov F.R., Rakhmanov F.A. Problems of using face image segmentation, identification, filtering, facial signs distribution criteria in determining personal biometric characteristics. // World Bulletin of Management and Law (WBML) Available Online at: https://www.scholarexpress. Net Volume-14, September-2022 ISSN: 2749-3601. Pp.91-94.

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