RECOGNITION OF REALTIME BASED PRIMITIVE GEOMETRY OBJECTS USING PERCEPTRON NETWORK

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Abstract— *The current problem in defining primitive geometric abstract concepts requires in-depth spatial knowledge. Where geometry is one of the fields of mathematics which is considered the most difficult to understand, so we need a pattern recognition system for primitive geometric objects in real time to make it easier to define abstract shapes on primitive geometric objects. In this study the system was built using the Delphi 7 programming language using the perceptron network. Measurement of system performance evaluation in this study uses two parameters, namely detection rate and false positive rate. The results of this research are that the primitive geometric object recognition system using the perceptron network model in this study is able to recognize an average of up to 80.00%. The detection rate percentage shows that this model can be used as a supportive approach for the recognition of geometric objects in video.*

Keywords: *Primitive Geometry, Real Time, Perceptron.*

Intisari—*Permasalahan saat ini didalam mendefinikan konsep abtrak geometri primitif dibutuhkan pengetahuan tentang keruangan yang mendalam. Dimana geometri merupakan salah satu bidang ilmu matematika yang dianggap paling sulit untuk dipahami, sehingga dibutuhkan suatu sistem pengenalan pola objek geometri primtif secara realtime untuk memudahkan mendefinisikan bentuk abstrak pada objek geometri primitif. Pada penelitian ini sistem dibangun menggunakan bahasa pemograman Delphi 7 dengan menggunakan jaringan perceptron. Pengukuran evaluasi unjuk kerja sistem pada penelitia ini menggunakan dua parameter yaitu detection rate dan false positive rate. Hasil penelitian ini sistem pengenalan objek geometri primitif menggunakan model jaringan perceptron pada penelitian ini mampu mengenali rata-rata hingga 80.00%. Persentase detection rate tersebut menunjukkan bahwa model ini dapat*

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digunakan sebagai salah satu pendekatan yang mendukung untuk pengenalan objek geometri pada video.

***Kata Kunci**: Geometri Primitif, Real Time, Perceptron.*

INTRODUCTION

Geometry is a branch of mathematics that studies the relationship between points, lines, angles, planes and shapes and shapes(Jelatu, Lim, and Ngoe 2019). The concept of geometry is abstract but can be shown in a semi-real or semi-concrete way (Wulandari & Ishartono, 2022). Geometry with abstract shapes on these real objects is two-dimensional geometry (flat shapes) and three-dimensional geometries (spatial shapes) (Butar-Butar et al., 2022). When compared to other fields in mathematics, geometry is one of the fields in mathematics which is considered the most difficult to understand (Nur'aini et al., 2017). It is important to define abstract shapes on geometric objects to make it easier to formulate and solve problems in everyday life (Wulandari & Ishartono, 2022). The abstract object must be explained precisely so that it is understood by students. However, until now the media that are often used by educators are considered to be unable to describe properly, especially for three-dimensional geometry(Joko Suratno 2022)(Ikashaum et al. 2021), where in designing buildings one has to design and calculate very carefully everything in order to get a beautiful and stable building (Nurjanah & Juliana, 2020) . Achieve this, it requires thinking skills related to in-depth spatial knowledge (Mega Teguh Budiarto, 2019).

There are many realistic applications of geometry in the field of Mathematics, including determining the geometric shape of a computer network topology, determining the angle of inclination when placing stairs(Devi Eka Wardani Meganingtyas 2021), determining the angle formed at what time and how many minutes, the displacement of a figure (Agriyanto et al., 2021).Object recognition research has been put forward by several previous researchers such as: (Musthofa et al., 2017) analyzing objects in patterns: characters, symbols and Indonesian islands using the ANN method and the perceptron network model. The introduction test uses the VB programming language with the same accuracy as manual calculations using excel. Similar research was also reported by (Ramadhani et al., 2017) in their research to determine character and symbol patterns using the ANN method and the perceptron network model. Determination of recognition based on 5 inputs, namely the weight value (w) = 0, the alpha value (α) = 1, and the threshold value (θ) = 0 for the initial stage analysis. Whereas for the second analysis using weight values (w) = 0, alpha values (α) = 0.25, 0.5, 0.75, and 1, and threshold values (θ) = 0. In 2022 similar research will also be found by (Purba et al., 2022) Using the perceptron method to detect photocopier damage, the results obtained are that the percepton method can be used to recognize patterns, especially patterns of damage symptoms. Where to get better accuracy results depends on the amount of data collected and trained on the system. Based on this description, we need a system that can be applied in learning media so that it makes it easier for educators and makes it easier for students to understand the abstract concepts that exist in primitive geometry. Based on this description, we need a system that can be applied in learning media so that it makes it easier for educators and makes it easier for students to understand the abstract concepts that exist in primitive geometry.

MATERIALS AND METHODS

A. Research Stage

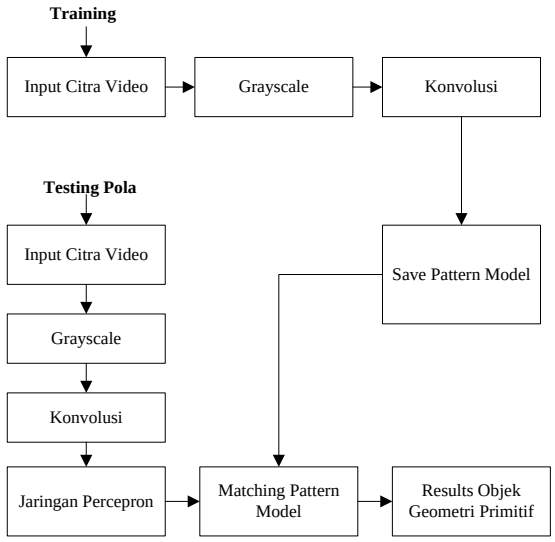

Figure 1. Research Stages.

In Figure 1 it can be seen the overall research steps in this study. Where in the training stage after the system receives the original video image input it will be pre-processing with grayscale and convolution then the pattern model will be stored to be used as a reference pattern at the testing stage. convolution and primitive geometry object pattern recognition tests using the Perceptron Network method then proceed to the pattern model matching stage if the pattern is similar or close to the training

pattern then the output of the recognition is the result of primitive geometry objects.

B. Data Collection

The dataset used in this study is image-based data taken directly (real-time). Video images for training and testing are obtained from various sources such as camera captures. The video image used is only limited to 24-bit video images with the AVI extension. The choice of the .AVI format is because the .AVI format is the default standard on the Windows operating system. The details are as follows :

Table 1 Samples of Primitive Geometry Objects (Real-Time)

Sampel Pelatihan Objek Geometri Primitif				
Kubus	Prisma	Tabung	Bola	Total Sampel
5	4	4	3	16

For real-time primitive geometric object samples captured directly by the camera. This real-time primitive geometry object sample is used as a comparison to see the accuracy of the primitive geometry object recognition system directly by carrying out the process of testing primitive geometry objects in real-time according to the conditions of the primitive geometry object during training.

C. Overall System Scheme

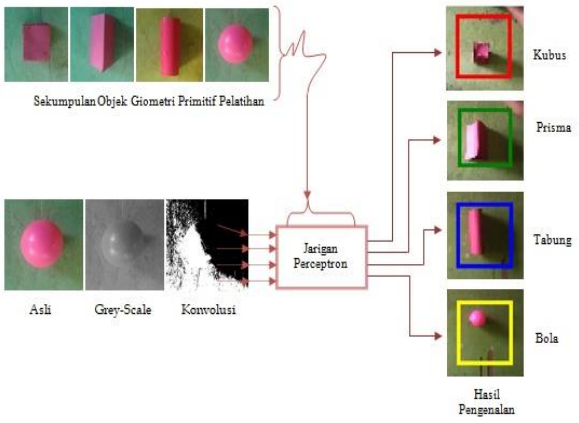

Figure 2. Overall System Scheme Overall System Scheme (Rizal, Purba, et al. 2020)(Rizal, Susanto, and Chandra 2020)

In Figure 2 you can see a schematic of the entire research system where after the system receives video image input it will be processed at the greyscale, convolution, and pattern recognition stages of primitive geometric objects using the Perceptron Network method. In the pre-processing stage, the original video as input will be resized first to save time and the number of iterations. After resizing the video will be represented in the form of one channel and ends with edge detection through the convolution process. In the main process, computation uses the Perceptron Network method, where primitive geometric object patterns will be trained to obtain a weight matrix and then the weight matrix will be used as a testing matrix.

C. System Performance Evaluation Measurement Parameters

The evaluation measurement of the performance of this primitive geometric object recognition system uses two parameters, namely the detection rate and the false positive rate. The detection rate is a comparison or percentage of the number of primitive geometric object recognition that can be detected, while the false positive rate is the number of objects detected not as primitive geometric objects.

RESULTS AND DISCUSSION

A. System Analysis

The results discussed include the selection of basic primitive geometry object training samples where these samples will be recorded in real-time on the .AVI video available on the system. System training, the system training process includes the process of calculating matrix values from the original image, then the gray-scale process, and the edge detection process using convolution with a kernel, namely the sobel operator. And then the matrix results from the edge detection process are transformed using the perceptron network to get energy from the image of the object. And the energy resulting from the transformation is stored in the database as recognition energy for the image object.

System testing, the steps in the system testing process are the same as the training process, where the original image matrix values will be processed in the gray-scale process and then entered in the edge detection process using convolution with a kernel, namely the sobel operator and transformed using a perceptron network to obtain the energy of an image. Furthermore, the image energy in the testing process will be compared with the image energy in the training process which was previously stored in the database. The approach or similarity of the energy value is the reference for the introduction of primitive geometric objects, this is also known as the statistical approach. System performance measurement is an overview of the results of the entire training and testing process that has been carried out. Which is described directly in the form

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of a table containing the actual data from the research results.

B. User Interface

In this program there are two projects, namely the first project is for training video image objects of primitive geometric cubes, prisms, tubes and balls while the second project is for testing video images of primitive geometric objects of cubes, prisms, tubes and balls. Real-time video images that have been trained will be tested to see the accuracy of the system in recognizing cubes, prisms, tubes and spheres in real time. The Primitive Geometry Object Training Program Interface can be seen in Figure 2.

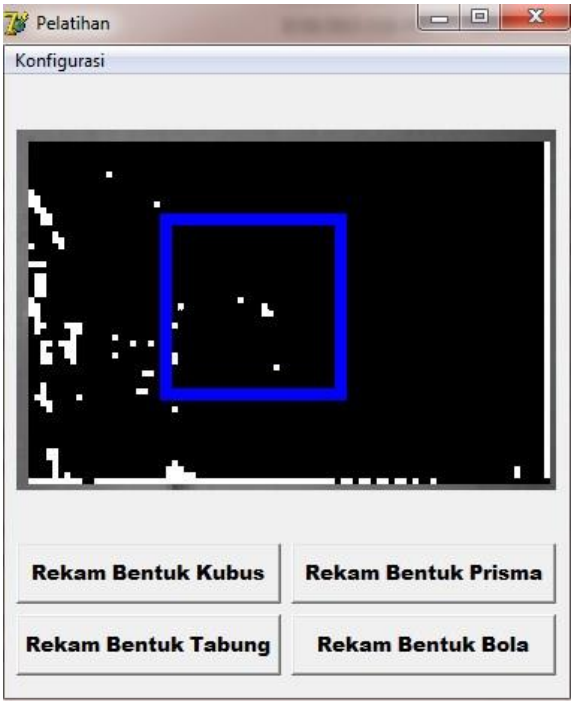


Figure 2. Primitive Geometry Object Training Program Interface

Figure 2 shows the overall Primitive Geometry Object Training Program interface. Where all primitive geometric objects with the shape of cubes, tubes, prisms and spheres must go through this training interface process to record the initial value as a reference for pattern recognition of the next primitive geometric object. Meanwhile, the Primitive Geometry Object Testing Program Interface can be seen in Figure 3.

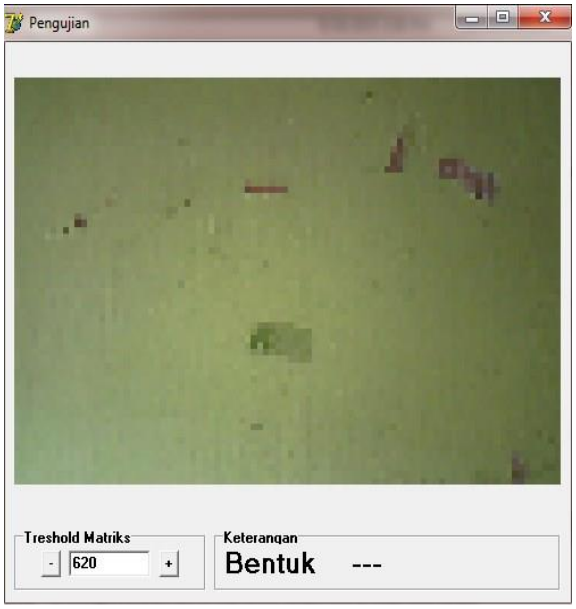
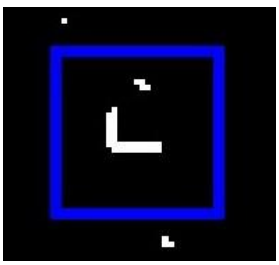
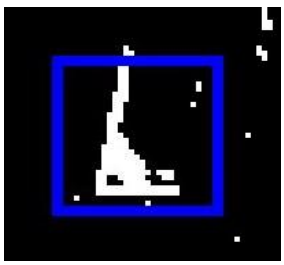


Figure 3. Primitive Geometry Object Testing Program Interface

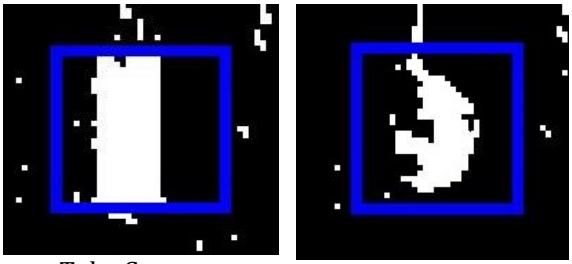
In Figure 3 you can see the video image testing program. Where primitive geometry objects are cubes, prisms, tubes and balls that have gone through the training process and will be tested to see the accuracy of the system in introducing primitive geometric objects. In this program there is a matrix threshold setting, to set the primitive geometric objects of cubes, prisms, tubes and balls when under certain conditions when objects are not immediately detected. If the object that has been tested belongs to the category of cubes, then there is a red template on the primitive geometry object of the cube. If the object that has been tested belongs to the category of prisms, there is a green template on the object of the primitive geometry of the prism. If the object being tested belongs to the tube category, then there is a blue template for the tube primitive geometry object, and if the tested object belongs to the spherical category, then the test program has a yellow template for the spherical primitive geometry object. The Primitive Geometry Object Training Process for Cube, Prism, Tube and Ball objects can be seen in Figure 4



a. Cube Geometry Objects



b. Prism Geometry Object



c. Tube Geometry Object

d. Ball Geometry Object

Figure 4. Geometry Object Training Sample (a) Cube (b) Prism (c) Tube (d) Ball

In Figure 4 it can be seen the training process of the geometric object is carried out. This training process is used for object recognition in the testing process, where training samples are taken via webcam.

C. Process of Testing Primitive Geometry Objects

The process of testing this primitive geometric object recognition system is processed after the process of recording image values in the previous training process. For the testing process the introduction of cube geometry objects is indicated by a red square box, while for the introduction of prism geometry objects it is indicated by a green square box, then for the introduction of tube geometry objects it is indicated by a blue square box, and for the introduction of spherical geometry objects it is indicated by a square box yellow. Can be seen in the image below.

Figure 5. Sample Testing Cube Geometry Objects

Figure 5 shows the results of testing the recognition of the correct cube geometry object which was successfully identified as a cube. The recognition results are marked with a red box.

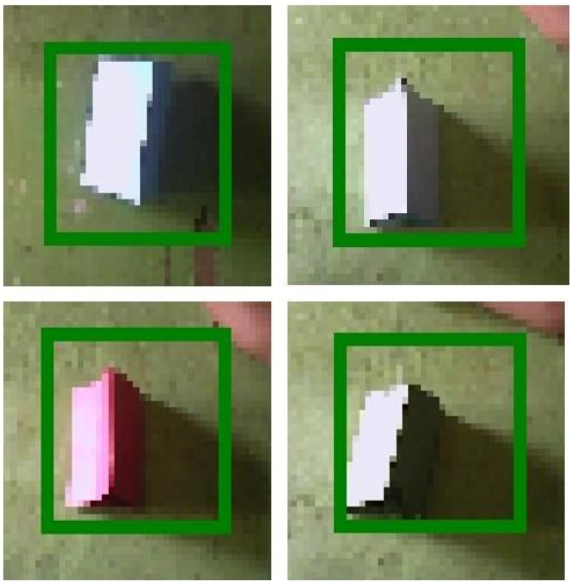


Figure 6. Samples of Prism Geometry Object Testing

Figure 6 shows the results of testing the recognition of the correct prism geometry object which was successfully identified as a prism. Recognition results are marked with a green box.

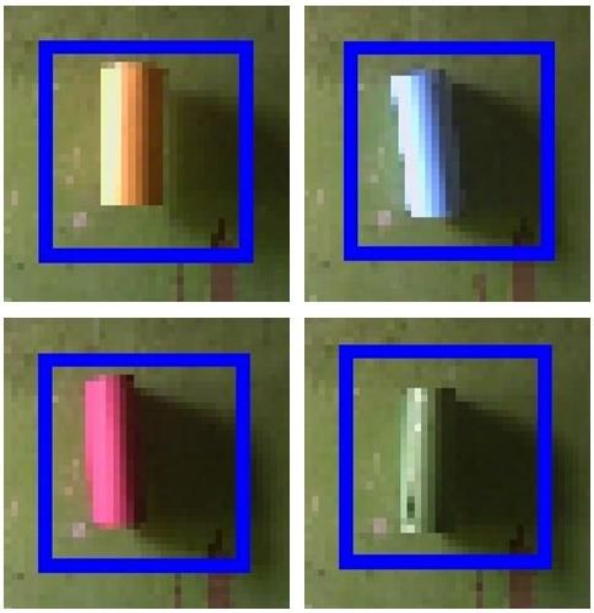


Figure 7. Testing Samples of Tube Geometry Objects

Figure 7 shows the results of testing the correct tube geometry object recognition which was successfully identified as a tube. Recognition results are marked with a blue box.

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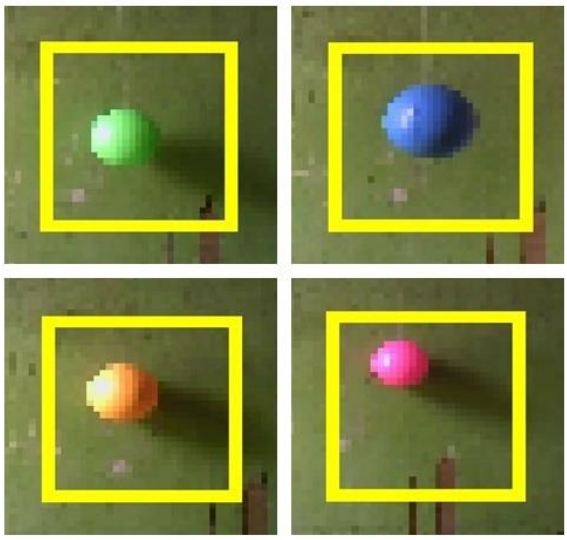

Figure 8. Ball Geometry Object Testing Samples

Figure 8 shows the results of testing the correct spherical geometry object recognition which was successfully identified as a ball. Recognition results are marked with a yellow box.

D. System Performance

In this study the measurement of system performance is based on all test data based on certain specifications or identification which is correlated with the number of training datasets used. The results of measuring system performance can be seen in table 2.

Table 2. Performance Results of Primitive Geometry Object Recognition Systems

Geometry Object Sample	Number of Training Images	Number of Testing Images	True detection	False detection	Persentase True detection	Persentase False detection
Cube	5	15	12	3	80.00 %	20.00 %
Prism	4	15	9	6	60.00 %	40.00 %
Tube	4	15	10	5	66.66 %	33.34 %
Ball	3	15	11	4	73.33 %	26.67 %

In table 2 it can be seen the trials that have been carried out in this study. In the cube object, the number of images used in training is 5 images and 15 images tested where the system can recognize 12 images and 3 images are not detected, while in the prism object the number of images used in training is 4 images and 15 images tested where the system can recognize 9 images and 6 images are not detected, then on tube objects the number of images used in training is 4 images and 15 images are tested where the system can recognize 10 images and 5 images are not detected and on ball objects the number of images used in training is 3 images and testing 15 images where the system can recognize 11 images and 4 images are not detected.

CONCLUSION

The results showed that the primitive geometric object recognition system using the Perceptron Network method has an average detection rate of 80.00%. The success rate of testing on this system is not only supported by the performance of sample geometric objects of cubes, prisms, tubes and ball but is also influenced by the light at the time the test is carried out, because the resolution of the video camera on this system is still relatively low. The detection rate percentage shows that this method can be used as a supportive approach for the recognition of geometric objects in video.

REFERENCE

Agriyanto, Sayudi, Iwan Setiawan, and Agus Susanta. 2021. "Representasi Spasial Siswa Pada Materi Geometri Ruang Selama Pembelajaran Matematika Realistik Berbasis Etnomatematika Bengkulu." Jurnal Pendidikan Matematika Raflesia 06(02):1–14.

Butar-Butar, Juli Loisiana, Ferdinand Sinuhaji, Agus Susanto Ginting, and Rafael Abadiken Sitepu. 2022. "Penggunaan Aplikasi Geogebra Sebagai Media Pembelajaran Geometri Di SMP Negeri 1 Berastagi." Jurnal Pengabdian Masyarakat Bestari 1(6):401–8. doi: 10.55927/jpmb.v1i6.1097.

Devi Eka Wardani Meganingtyas. 2021. "Pemanfaatan Software Cabri, GeoGebra, Dan SketchUp Sebagai Media Visualisasi Konsep Matematika Pada Materi Geometri Ruang." Jurnal Riset Pendidikan Matematika Jakarta 3(1):67–75. doi: 10.21009/jrpmj.v3i1.20122.

Ikashaum, Fertilia, Juitaning Mustika, Endah Wulantina, and Edo Dwi Cahyo. 2021. "Analisis Kesalahan Representasi Simbolik Mahasiswa Pada Soal Geometri Analitik Bidang." Al-Khwarizmi : Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam 9(1):57–68. doi: 10.24256/jpmipa.v9i1.1701.

Jelatu, Silfanus, Maria Lim, and Maria Yasinta Ngoe. 2019. "Pengenalan Bentuk Geometri Bagi Anak Usia Dini Dan Sekolah Dasar Kelas Rendah Melalui Origami." Jurnal Pengabdian Pada Masyarakat 4(2):195–202. doi: 10.30653/002.201942.134.

Joko Suratno, Ida Kurnia Waliyanti. 2022. "PEMBUATAN ORNAMEN GEOMETRIS DENGAN SOFTWARE GEOMETRI INTERAKTIF." Jurnal Pendidikan Guru Matematika 2(3):12–26.

Mega Teguh Budiarto, Rudianto Artiono. 2019. "Dalam Pembelajarannya." J U M A D I K A II(1):1–13.

Musthofa, Muhammad Ulinnuha, Zufida Kharirotul Umma, and Anik Nur Handayani. 2017. "Analisis Jaringan Saraf Tiruan Model Perceptron Pada Pengenalan Pola Pulau Di Indonesia." Jurnal Ilmiah Teknologi Informasi Asia 11(1):89. doi: 10.32815/jitika.v11i1.56.

Nur'aini, Indah Linda, Erwin Harahap, Farid H. Badruzzaman, and Deni Darmawan. 2017. "Pembelajaran Matematika Geometri Secara Realistis Dengan GeoGebra." Matematika 16(2):1–6. doi: 10.29313/jmtm.v16i2.3900.

Nurjanah, Nurjanah, and Anggi Juliana. 2020. "Hambatan Didaktis Siswa SMP Dalam Penyelesaian Masalah Geometri Berdasarkan Kemampuan Persepsi Ruang." Kreano, Jurnal Matematika Kreatif-Inovatif 11(2):236–44. doi: 10.15294/kreano.v11i2.26752.

Purba, Depanri, Saniman Saniman, and Ardianto Pranata. 2022. "Implementasi Perceptron Untuk Mendiagnosa Kerusakan Mesin Fotocopy." Jurnal Sistem Informasi Triguna Dharma (JURSI TGD) 1(4):314. doi: 10.53513/jursi.v1i4.5292.

Ramadhani, Irfan, Selly Handik Pratiwi, and Anik Nur Handayani. 2017. "Analisis Jaringan Saraf Tiruan Pengenalan Pola Huruf Hiragana Dengan Model Jaringan Perceptron." Jurnal Ilmiah Teknologi Informasi Asia 11(1):45. doi: 10.32815/jitika.v11i1.41.

Rizal, Reyhan Achmad, Nurlela Octavia Purba, Lidya Aprilla Siregar, Kristina Sinaga, and Nur Azizah. 2020. "Analysis of Tuberculosis (TB) on X-Ray Image Using SURF Feature Extraction and the K-Nearest Neighbor (KNN) Classification Method." Jaict 5(2):9. doi: 10.32497/jaict.v5i2.1979.

Rizal, Reyhan Achmad, Mario Susanto, and Andy Chandra. 2020. "Classification Of Borax Content In Tomato Sauce Through Images Using GLCM." SinkrOn 4(2):6. doi: 10.33395/sinkron.v4i2.10508.

Wulandari, Tia Ayu, and Naufal Ishartono. 2022. "Analisis Kemampuan Representasi Matematika Siswa SMA Dalam Menyelesaikan Soal Geometri Berdasarkan Level Berpikir Van Hiele." JNPM (Jurnal Nasional Pendidikan Matematika) 6(1):97. doi: 10.33603/jnpm.v6i1.5330.