Indonesian Journal of Electrical Engineering and Computer Science
Vol. 26, No. 2, May 2022, pp. 1018~1026
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v26.i2.pp1018-1026

Matic motorcycle transmission damage detection system using internet of things-based expert system

Suhadi[1,3], Muhamad Nur[1], Sulistyowati[1], Amat Suroso[2]
[1]Informatics Engineering, STMIK Bani Saleh Bekasi, Bekasi, Indonesia
[2]Informations System, STMIK Bani Saleh Bekasi, Bekasi, Indonesia
[3]Ministry of Marine Affairs and Fisheries Republic of Indonesia, Jakarta, Indonesia

Article Info

Article history:

Received Mar 1, 2021
Revised Mar 6, 2022
Accepted Apr 16, 2022

Keywords:

Arduino UNO
Case-based reasoning
Internet of things
Rontinuous variable transmission
Vibration Sensors

ABSTRACT

The development of the motorcycle industry in Indonesia has developed quite significantly from year to year, the Central Statistics Agency noted that in 2019 the number of motorcycle sales reached 106,657,952 units, and the Indonesian motorcycle industry association (AISI) in 2020 the type of scooter (matic) of 2,696,557 units or 87.9%, this automatic type of motorbike is the largest contributor to two-wheeled vehicles and is the favorite type of vehicle for Indonesians. Automatic transmission or what is known as continuous variable transmission (CVT), is an automatic speed transfer system according to engine speed using a V-belt. In previous research, the use of internet of things (IoT) is used as an automatic air quality monitoring control system, air quality conditions can be seen quickly and accurately from the monitor. The goal of this study is to use a vibration sensor and the case-based reasoning (CBR) method to solve damage to matic motor components. The results of this study are: i) the case average value is 0.76, ii) the CVT component parameter is 80% the average value is 0.94, and iii) the CVT component weight parameter is from 60% the average value is 1.26.

Corresponding Author:

Suhadi
Informatics Engineering, STMIK Bani Saleh Bekasi
Jl. Mayor Madmuin Hasibuan No. 68, Kota Bekasi, Jawa Barat 17113, Indonesia
Email: hadims71ndl@gmail.com

1. INTRODUCTION

The primary goal of transmission detection on automatic motors is to ensure the safety and efficiency of users when riding their motorcycles. Sharp objects can cause damage to V-belts, which are readily torn, and such damage is difficult to detect in a timely manner. These issues have the potential to cause a significant crash in a short period of time. Therefore, the automatic motorcycle transmission damage detection system using internet of things (IoT) based expert system is very important and can be used by people as a reference or motorcycle repair shop to detect it early and in detail. Most existing systems only apply images to identify one type of damage and are less accurate and valid.

Transmission is a component that functions to transfer power from the engine to the wheels by setting torque or momentum according to several conditions. if simplified this transmission becomes a supplier of engine power. The automatic motorcycle transmission has many components and is interrelated, its function is to connect the engine and the rear wheels using a belt [1]. Every component of an automatic motorcycle transmission has a lifetime due to the distance traveled, if it is worn or needs to be replaced. Just like other components, automatic motorcycle transmissions also cause symptoms before they are completely damaged. To find out the damage to the transmission component of an automatic motorcycle, it must be checked by an expert or expert, namely a mechanic, so it takes a longer time and costs to check for symptoms on components that are considered damaged.

In this study, the detection system uses an expert system based on case-based reasoning (CBR) which is proposed based on visual objects, the use of sensors to detect symptoms on the V-belt of an automatic motorcycle, the process used is to calculate the sensor emitted to the object on the V-belt and send it to the V-belt. decision-making subsystem through the data transmission subsystem on the microcontroller. With the development of increasingly advanced technology, information technology has become an important part in various fields of life, therefore technology can also be used in the automotive sector to obtain information about the symptoms of motorcycle damage, especially the symptoms of automatic motorcycle damage, some symptoms of automatic transmission damage often occur. on the vibrations that can be felt. Internet of things or what is called IoT is a concept that has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [2].

In a prior study, the connected components of a multi-class support vector machine (SVM) detection system based on visual saliency of damage were retrieved and placed x using an adjustable threshold. Using a multi-class SVM model, gray values were immediately selected as crucial values and utilized to detect the location and type of damage. The system reacts to the output in real-time. While the detection accuracy for all types of damage is improved, it still falls short of 100%. Even in difficult environments, the detection accuracy is 99.11%, and the defect can be reported, stopped, and attended to in a timely manner to protect the safety of the people and equipment involved. The purpose of using the internet of things (IoT) is to connect hardware and software equipment that is integrated to the internet between micro-devices embedded in certain devices and as an alternative for detection of faults in general and integrated with other supporting equipment [3], [4].

2. RESEARCH METHOD

Detection is a process to examine or examine something by using certain methods and techniques. Detection can be used for various problems, for example in the detection system of an automatic transmission malfunction, where the system identifies problems related to an automatic transmission which are commonly called symptoms or damage. The purpose of detection is to solve a problem in various ways depending on the method applied so as to produce a solution [5]. CBR is a problem-solving method that emphasizes the value of previous experience in resolving future issues. It has been quite successful in a variety of problem-solving activities and sectors. After a brief overview of CBR's conventional problem-solving cycle, we discuss the cognitive science foundations of CBR and its relation to analogical reasoning. We then go over a selection of retrieval, reuse, revision, and retention research from the last few decades [6].

2.1. Case-based reasoning (CBR)

Case-based reasoning (CBR) is a knowledge-based problem-solving strategy for analyzing and solving problems based on previous experiences, also known as case-based reasoning [7], as in Figure 1. CBR is a concept of artificial intelligence (AI) is a new approach and the theory has been employed in some subsequent studies intelligent dynamic spectrum resource management, which is based on massive amounts of sensing data from industrial IoT in the space-time and frequency domains employs optimization algorithm-based decisions to reduce interference levels in areas like energy consumption, power control, idle channel allocation, time slot allocation, and spectrum handoff. In this scenario, data mining and case-based reasoning are used to assess incumbent users' activity patterns utilizing enormous volumes of sensing data from industrial IoT and enable quick resource allocation using case database sorted by case [8].

The actions that can be followed in this retrieve process to bring back the same or comparable cases with fresh cases that have just been encountered are problem identification, start matching, and selection [9]. In this reuse procedure, the system will search the database for problems by identifying new problems, and then it will reuse knowledge from previous problems that have comparable characteristics to solve new problems. The reuse procedure is based on two factors first, the difference between the prior and current cases, and second, the portion of the old case that has been obtained will be sent as a new case [10].

A review of the solutions that have been gained on the topic will be carried out or improved during this review procedure. The major responsibilities of this revision stage are to re-evaluate the solutions obtained during the raising phase. If it is successful, it will advance to the next step, which is the retention procedure. If not, the system will use a specific area of expertise to further refine the case solution gained via the retention procedure [11]. They keep step is the last in the CBR system, and it involves the system saving new problems and then entering them into the knowledge base, where they will be utilized to solve future problems [12]. The similarity is a concept of similarity that is used for existing problems that are not exactly the same as the problems in the past cases, the formula for calculating Similarity uses the formula (1) and (2).

$$similarity\ (A,B) = \frac{1}{\sum wi} . \sum_{i=1}^{p} w_i . sim_i(a.b) \quad (1)$$

$$similarity\ (p,q) = \frac{\sum_{i=1}^{n} f(pi,qi) X wi}{wi} \quad (2)$$

where: *A*: is the new case, *B:* is preview cases, *a*: is the new feature from local similarity, *b*: is previews feature from local similarity, *p:* is the number of attributes, *q:* is the case in storage, *f:* is similarity attribute function, w_i: is weight of attributes, sim_i attributes: is local Similarity calculate for attribute.

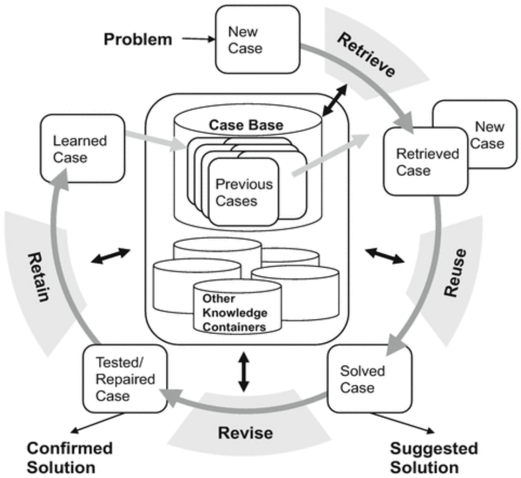


Figure 1. Scheme of case-based reasoning

2.2. Vibration sensor

This vibration sensor, also known as a vibration sensor, is a test instrument or a measurement device that is used to count the number of frequencies in the vibration of a system, machine, or other equipment. This statistic can also be used to identify several flaws in a tool (that has been tested) and forecast future failures [13]. The tool’s working principle is as follows there is a case insulator in the acceleration probe that is in direct contact with the machine to be examined this case insulator acts as a transmitter, transmitting vibrations from the machine to the piezoelectric, causing the piezoelectric to experience a pressure proportional to the vibration received from the machine. The piezoelectric material will be impacted by mechanical vibrations that induce a force, causing the piezoelectric material to produce an electric charge [14].

However, because the piezoelectric generates such a little electric current, other tools are required to generate a conventional electric charge. Because the electric charge generated by the piezoelectric is so little, it is equipped with an electrical circuit/amplifier that can generate a charge, allowing the electric charge generated to be amplified. A vibration sensor is a tool that functions to detect vibrations and will be converted into an electrical signal. Vibration sensors have high sensitivity to vibration, and are used for the benefit of an experiment or will be used to anticipate if something goes wrong, the vibration sensor used is a type of vibration sensor 801 s [15].

A microcontroller, also known as a micro chip unit (MCU) or a C, is an electrical component or integrated circuit (IC) with a variety of features and components, similar to a computer [16], [17]. The central processing unit (CPU) or centralized processing unit, code memory, data memory, and I/O (input and output ports) are all part of a single chip computer that may be used to manage the system; the microcontroller utilized is the type ESP8266 [16], [18].

2.3. Hardware design

Designing a hardware system is to provide a general overview to the user about the newly designed hardware system, so that the user will be easy to learn in detail. The design or system design concentrates on how the system is built to meet the needs of the analysis phase [19], [20]. In this research, the design of a vibration detection system that utilizes the 801s series vibration sensor as input, the sensor sends a vibration value signal to the continuous variable transmission (CVT), then is processed by the ESP8266 module which is configured with the Arduino IDE application software as a process, then from the configuration it will be sent using the IP adress which associated with the hotspot signal on the ESP8266 serial and the final result is the value that has been processed using the CBR method, which can be seen on the screen and smartphone as output, as in Figure 2.

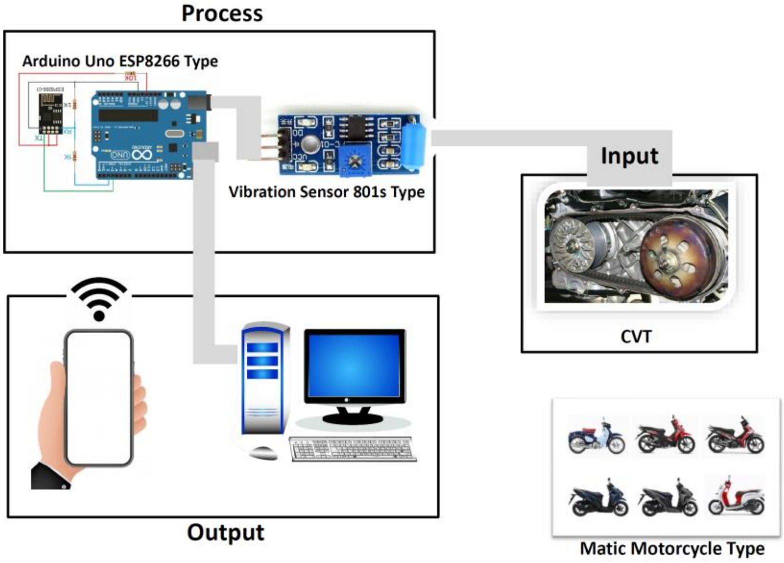


Figure 2. Automatic transmission process mechanism

3. RESULTS AND DISCUSSION

To predict whether the machine is damaged or not, the use of variables as old cases will then be calculated based on new cases consisting of case table model variables [21], cases on automatic equipment in Table 1. In Table 2, the weight of the equipment parameters is used as a reference to determine the assessment of the components (0.8) and the condition (0.6) of the components that have been used.

Table 1. Cases on automatic equipment

No.	Component	Condition	Solution
1	Roller CVT	Thin	Replace new
2	Box roller	Dirty	Component repaired
3	Box roller	Thin	Replace new
4	Canvass CVT	Dirty	Component repaired
5	Cup CVT	Thin	Replace new
6	Cup CVT	Dirty	Component repaired
7	Cup CVT	Thin	Replace new

Table 2. Equipment parameter weights

No.	Equipment	Paramater weights
1	Componen	0.8
2	Condition	0.6

The variable weight value of the vibration component [22] in Table 3 is the value used for all components on the motor matic with reference to the values that have been set based on the previous analysis and the variables used are 28 types of examples, the range of values used is 0.4 to 1. Whereas in Table 4 it is used to assess the condition of the weighted components of each equipment referring to the strength of the components themselves [23], whether the components are thin with a value of 1 and dirty with a value of 0.5. To test and calculate the proximity of new cases, 10 trials have been carried out using the V-belt component as an object with the following results.

Table 3. Weight of the component's vibration value

No.	Value component 1	Value component 2	Proximity weights
1	Roller CVT	Roller CVT	1
2	Canvass CVT	Canvass CVT	1
3	Cup roller	Cup roller	1
4	Cup CVT	Cup CVT	1
5	Roller CVT	Canvass CVT	0.8
6	Roller CVT	Cup roller	0.6
7	Roller CVT	Cup CVT	0.4
8	Canvass CVT	Roller CVT	0.8
9	Canvass CVT	Cup roller	0.7
…	…	…	…
28	Cup CVT	Cup roller	0.8

Table 4. Weighted component condition value

No.	Equipment	Paramater weights
1	Thin	1
2	Dirty	1
3	Thin	0.5
4	Dirty	0.5

3.1. New proximity to number cases-1

Variables: (a) Proximity component attribute weights (CVT roller with Canvass CVT)=0.8, (b) Component attribute weights=0.8, (c) Proximity condition weight (thin to thin)=1, and (d) Condition attribute weight=0.6.

$$\begin{aligned} similarity &= \frac{((a\times b)+(c\times d))}{b+d} \\ &= \frac{((1\times 2)+(3\times 4))}{2+4} \\ &= \frac{((1\times 2)+(3\times 4))}{2+4} \\ &= \frac{((0.8\times 0.8)+(1\times 0.6))}{0.8+0.6} \\ &= \frac{0.64+0.6}{1.4} = \frac{1.24}{1.4} \\ &= 0.888 \end{aligned} \quad (3)$$

3.2. New proximity to number cases-2

Variables: (a) Proximity of vibration value attribute weight (CVT roller with roller cup)=0.6, (b) Weight attribute vibration value=0.8, (c) Proximity condition weight (gross to gross)=1, and (d) Condition attribute weight=0.6.

$$\begin{aligned} similarity &= \frac{((a\times b)+(c\times d))}{b+d} \\ &= \frac{((0.6\times 0.8)+(1\times 0.6))}{0.8+0.6} \\ &= \frac{0.48+0.6}{1.4} = \frac{1.08}{1.4} \\ &= 0.908 \end{aligned} \quad (4)$$

3.3. New proximity to number cases-10

Variable: (a) Proximity of vibration value attribute weight (Canvass CVT with roller housing)=0.7, (b) Weight attribute vibration value=0.8, (c) Proximity condition weight (thin to gross)=0.5, and (d) Condition attribute weight=0.6.

$$\begin{aligned} similarity &= \frac{((a\times b)+(c\times d))}{b+d} \\ &= \frac{((0.7\times 0.8)+(0.5\times 0.6))}{0.8+0.6} \\ &= \frac{0.56+0.3}{1.4} = \frac{0.88}{1.4} \\ &= 0.614 \end{aligned} \quad (5)$$

By testing the experiment 10 times, several criteria and values can be generated from the components and conditions as in Table 5.

Table 5. Test results of CVT equipment

Cases	Similarity score results	Equipment parameter weights		Solution
		Component (80%)	Conditiaon (60%)	
X1	0.888	1.11	1.48	Replace new
X2	0.908	1.14	1.51	Replace new
X3	0.528	0.66	0.88	Component repaired
X4	0.854	1.07	1.42	Replace new
X5	0.988	1.24	1.65	Replace new
X6	0.671	0.84	1.12	Component repaired
X7	0.557	0.70	0.93	Component repaired
X8	0.657	0.82	1.10	Component repaired
X9	0.885	1.11	1.48	Replace new
X10	0.614	0.77	1.02	Component repaired

To find out the movement or similarity score result fluctuating based on the value of the CVT test results based on 10 trials, it can be seen in Figure 3. To find out the movement or ratio equipment parameter weight component and condition fluctuating based on the value of the CVT test results as shown Figure 4 based on 10 trials, it can be seen in Figures 4(a) and (b).

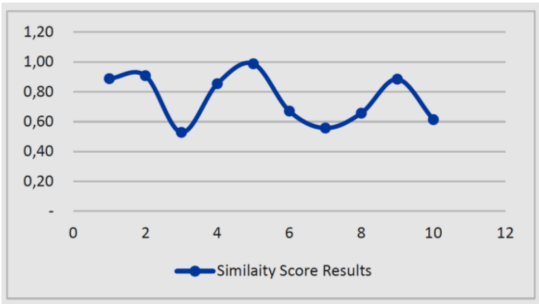
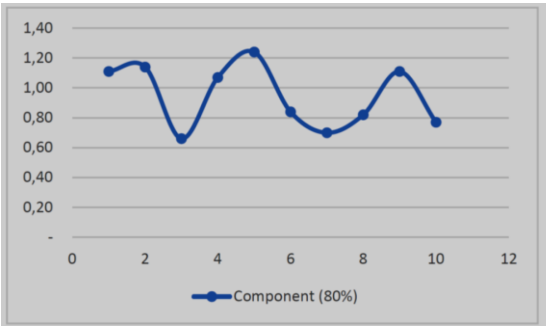
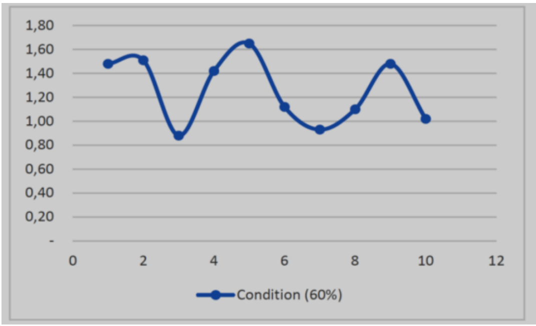


Figure 3. Fluctuation test results of CVT equipment trials



(a)



(b)

Figure 4. Ratio equipment parameter wight fluctuation test results of CVT equipment trials based on (a) component and (b) conditions

To find out the calculation of the error in the sensor against the object, it can be done by comparing it with a measuring instrument with a vibration sensor, it can be calculated based on (6):

$$Error = \frac{x-y}{y} x\ 100\% \quad (6)$$

where:
x = Measurement by ultrasonic sensor (cm)
y = Measurement by ruler (ruler) (cm)

This means that the sensor can only work with a distance of at least 2 cm and a maximum of 30 cm. In general, the farther the distance measured, the smaller the error. The difference in the distance between the test results and the actual distance can be caused by noise [24], the vibration sensor can read distances in multiples of 0.5 cm, the test results are as follows:

$$\text{Trials Test} - 1\ \ Error = \frac{2{,}00-1{,}50}{1{,}50} x\ 100\% = 33{,}33\%$$
$$\text{Trials Test} - 2\ \ Error = \frac{3{,}50-3{,}00}{3{,}50} x\ 100\% = 16{,}66\%$$
Trials Test…
$$\text{Trials Test} - 19\ \ Error = \frac{29{,}00-28{,}50}{28{,}50} x\ 100\% = 1{,}75\%$$
$$\text{Trials Test} - 20\ \ Error = \frac{30{,}00-30{,}00}{30{,}00} x\ 100\% = 0\%$$

The test is carried out to determine the value of the sensor error and the V-belt object [25], namely by attaching the sensor from the closest (2 cm) to the furthest (30 cm), the closer the sensor is to the test object, the more precise the error value is 33.33% and the lowest is 0%, the conclusion is the closer the object to the sensor the more accurate it is and the farther away the object from the sensor the less accurate it is, as shown in Table 6.

Table 6. Recapitulation of error test trial results

Trial test	x (sensor)	y (ruler)	y (ruler)	Error result (x-y)/y*100
1	2.00	1.50	1.50	33.33
2	3.50	3.00	3.00	16.66
3	5.00	4.50	4.50	11.11
4	6.50	6.00	6.00	8.33
5	8.00	7.50	7.50	6.66
6	9.50	9.00	9.00	5.55
7	11.00	10.50	10.50	4.76
8	12.50	12.00	12.00	4.16
9	14.00	13.50	13.50	3.70
10	15.50	15.00	15.00	3.33
11	17.00	16.50	16.50	3.03
12	18.50	18.00	18.00	2.77
13	20.00	19.50	19.50	2.56
14	21.50	21.00	21.00	2.38
15	23.00	22.50	22.50	2.22
16	24.50	24.00	24.00	2.08
17	26.00	25.50	25.50	1.96
18	27.50	27.00	27.00	1.85
19	29.00	28.50	28.50	1.75
20	30.00	30.00	30.00	-

4. CONCLUSION

IoT technology has a very high potential to be implemented and integrated into sensor systems, and it is possible to detect certain parts of an automatic motor, namely a V-belt motor using a vibration sensor. The sensor reads various parameters to monitor information on the V-belt, the data and information are then sent to a laptop, smartphone, or cloud computing via wifi which is then used by mechanics for further analysis. Based on the trials conducted ten times, it can be concluded that: i) the average value of the similarity of cases is 0.76; ii) the calculated value of the CVT component parameter weight of 80% the average value is 0.94; and iii) calculate the weight parameter of the CVT component from 60% of the mean value of 1.26. The calculation solution for the CVT equipment from the experimental results are; i) cases X1, X2, X4, X5, and X9 new cases are CVT equipment must be replaced; and ii) cases X3, X6, X7, X8, and X10 new cases are CVT equipment only repaired components. While the error for measurements between the V-belt object and the closest sensor (2 cm) with a value of 33.33% and the farthest distance (30 cm) with a value of 0%, this indicates that the farther away the object from the sensor is, the less accurate it is. To analyze the suggested model, the findings demonstrate that it is still restricted to vibration sensors; however, in the future, multi sensors can be added to offer precision in the test, and the tools used will be more complicated, either from an integrated system or by comparing it using two techniques.

REFERENCES

[1] M. M. Hossain, M. S. Islam, N. F. Dipu, M. T. Islam, S. A. Fattah, and C. Shahnaz, “Design of a low cost anti-theft sensor for motorcycle security device,” in *2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC)*, Dec. 2017, pp. 778–783, doi: 10.1109/R10-HTC.2017.8289072.

[2] M. Sabari, P. Aswinth, T. Karthik, and B. Kumar, "Water quality monitoring system based on IoT," in *2020 5th International Conference on Devices, Circuits and Systems (ICDCS)*, Mar. 2020, pp. 279–282, doi: 10.1109/ICDCS48716.2020.243598.
[3] F. Li, A. Shinde, Y. Shi, J. Ye, X.-Y. Li, and W. Song, "System statistics learning-based IoT security: feasibility and suitability," *IEEE Internet of Things Journal*, vol. 6, no. 4, pp. 6396–6403, Aug. 2019, doi: 10.1109/JIOT.2019.2897063.
[4] D. Leake and D. Crandall, "On bringing case-based reasoning methodology to deep learning," in *Case-Based Reasoning Research and Development. ICCBR 2020. Lecture Notes in Computer Science*, vol. 12311 LNAI, 2020, pp. 343–348.
[5] A. G.-Vidal, J. C.-Jara, and A. F. Skarmeta, "IoT for water management: towards intelligent anomaly detection," *IEEE 5th World Forum on Internet of Things, WF-IoT 2019 - Conference Proceedings*, 2019, pp. 858–863, doi: 10.1109/WF-IoT.2019.8767190.
[6] W. Bannour, A. Maalel, and H. H. B. Ghezala, "Case-based reasoning for crisis response: case representation and case retrieval," *Procedia Computer Science*, vol. 176, 2020, pp. 1063–1072, doi: 10.1016/j.procs.2020.09.102.
[7] S. K. Pal and S. C. K. Shiu, *Foundations of soft case-based reasoning*. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2004.
[8] D.-W. Yun and W.-C. Lee, "Intelligent dynamic real-time spectrum resource management for industrial IoT in edge computing," *Sensors*, vol. 21, no. 23, p. 7902, Nov. 2021, doi: 10.3390/s21237902.
[9] F. M. Kasie and G. Bright, "Integrating fuzzy case-based reasoning, parametric and feature-based cost estimation methods for machining process," *Journal of Modelling in Management*, vol. 16, no. 3, pp. 825–847, Jul. 2021, doi: 10.1108/JM2-05-2020-0123.
[10] H. Kaindl, R. Hoch, and R. Popp, "Estimating problem instance difficulty," in *Proceedings of the 22nd International Conference on Enterprise Information Systems*, 2020, pp. 359–369, doi: 10.5220/0009390003590369.
[11] S. Craw and A. Aamodt, "Case based reasoning as a model for cognitive artificial intelligence," 2018, pp. 62–77.
[12] E. P. Purwandari, A. P. Yani, R. Sugraha, K. Anggriani, and E. Widi Winarni, "Online expert systems for bamboo identification using case based reasoning," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 7, no. 5, p. 2766, Oct. 2017, doi: 10.11591/ijece.v7i5.pp2766-2772.
[13] D. Breitenbacher, I. Homoliak, Y. L. Aung, N. O. Tippenhauer, and Y. Elovici, "HADES-IoT: a practical host-based anomaly detection system for IoT devices," in *Proceedings of the 2019 ACM Asia Conference on Computer and Communications Security*, Jul. 2019, pp. 479–484, doi: 10.1145/3321705.3329847.
[14] A. Maier, A. Sharp, and Y. Vagapov, "Comparative analysis and practical implementation of the ESP32 microcontroller module for the internet of things," in *2017 Internet Technologies and Applications (ITA)*, Sep. 2017, pp. 143–148, doi: 10.1109/ITECHA.2017.8101926.
[15] R. Yanagisawa *et al.*, "Wearable vibration sensor for measuring the wing flapping of insects," *Sensors*, vol. 21, no. 2, p. 593, Jan. 2021, doi: 10.3390/s21020593.
[16] A. A. Rafiq, S. D. Riyanto, and R. Wardani, "An improved electricity efficiency method based on microcontroller and IoT with infrared sensor," *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, vol. 18, no. 2, p. 985, Apr. 2020, doi: 10.12928/telkomnika.v18i2.14889.
[17] S. Sakib, M. M. Fouda, Z. M. Fadlullah, N. Nasser, and W. Alasmary, "A proof-of-concept of ultra-edge smart IoT sensor: a continuous and lightweight arrhythmia monitoring approach," *IEEE Access*, vol. 9, pp. 26093–26106, 2021, doi: 10.1109/ACCESS.2021.3056509.
[18] S. S. Mohammed Sheet and M. S. Jarjees, "Microcontroller based in vitro hematocrit measurement system," *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS)*, vol. 18, no. 2, p. 717, May 2020, doi: 10.11591/ijeecs.v18.i2.pp717-723.
[19] J. G. Kurebwa and T. Mushiri, "Internet of things architecture for a smart passenger-car robotic first aid system," *Procedia Manufacturing*, vol. 35, 2019, pp. 27–34, doi: 10.1016/j.promfg.2019.05.006.
[20] A. Murad, O. Bayat, and H. M. Marhoon, "Implementation of rover tank firefighting robot for closed areas based on arduino microcontroller," *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS)*, vol. 21, no. 1, pp. 56–63, Jan. 2021, doi: 10.11591/ijeecs.v21.i1.pp56-63.
[21] A. Latief, A. Sihabudin, and D. Widowati, "Planned behavior in overcoming cognitive dissonance in ritual activities of homecoming (case study of homecoming travelers using motorcycle)," *Asian Research Journal of Arts & Social Sciences*, pp. 43–55, Dec. 2020, doi: 10.9734/arjass/2020/v12i230188.
[22] A. Dębowski, "Analysis of the effect of mass parameters on motorcycle vibration and stability," *Energies*, vol. 14, no. 16, p. 5090, Aug. 2021, doi: 10.3390/en14165090.
[23] F. Khaliullin, R. Akhmetzyanov, F. Arslanov, and A. Caview, "Methodology for determining standards of technical operation of vehicles taking into account their technical condition," in *Engineering for Rural Development*, May 2021, vol. 20, pp. 912–918, doi: 10.22616/ERDev.2021.20.TF206.
[24] R. Bridgelall and D. Tolliver, "Accuracy enhancement of anomaly localization with participatory sensing vehicles," *Sensors*, vol. 20, no. 2, p. 409, Jan. 2020, doi: 10.3390/s20020409.
[25] S. R. Battula, K. R. Chittireddy, M. Pullurwar, and K. K. Sriramoju, "Thermal performance of corrugated plate heat exchanger using ethylene glycol as test fluid," *Journal of Mechanical and Energy Engineering*, vol. 4, no. 2, pp. 167–172, Nov. 2020, doi: 10.30464/jmee.2020.4.2.167.

BIOGRAPHIES OF AUTHORS

Suhadi Graduated from Master of Informatics Engineering (M.Kom), Informatics Engineering Study Program, STMIK Eresha-Jakarta in 2011. Functional Computer Institutions of the Directorate of Licence and Fisheries, Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia. In 2016 until now he is active as a Lecturer at the College of Information Management and Computers (STMIK) Bani Saleh Bekasi-West Java, Informatics Engineering Study Program. Research in the fields of Software Engineering, Data Mining, Intelligent Systems and Digital Forensics. He can be contacted at email: hadims71ndl@gmail.com

Muhammad Nur Graduated from Master of Informatics Engineering (M.Kom), Informatics Engineering Study Program, STMIK Eresha-Jakarta in 2011. In 2016 until now he is active as a Lecturer at the College of Information Management and Computers (STMIK) Bani Saleh Bekasi-West Java, Informatics Engineering Study Program. Research in the fields of Software Engineering, Artificial Intelligent and Internet of Things. She can be contacted at email: muhamadn5879@gmail.com

Sulistyowati Graduated from Master of Management (M.M), Management Science, STIM-LPMI in 2008. In 2002 until now he is active as a Lecturer at the College of Information Management and Computers (STMIK) Bani Saleh Bekasi-West Java, Informatics Engineering Study Program. Research in the fields of Software Engineering and Data Science. He can be contacted at email: hs.sulistyowati@gmail.com

Amat Suroso Graduated from Master of Informatics Engineering (M.Kom), Informations System Study Program, STMIK Eresha-Jakarta in 2013. In 2016 until now he is active as a Lecturer at the College of Information Management and Computers (STMIK) Bani Saleh Bekasi-West Java, Information Technology Study Program. Research in the fields of Research in the fields of Application System, Database System and IT Governance. He can be contacted at email: ahmad_suroso04@yahoo.com