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Littering Activities Monitoring using Image Processing

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ABSTRACT

Littering is a human behavior that become a habit since childhood. Even though there are rules that prohibit this behavior, the community still continues to do so. In order to limit this bad behavior, a device that can monitor and provide notifications is needed. In this research, proposed device can identify human activities by utilizing webcam-based image processing. It is processed by machine learning using the Recurrent Neural Network (RNN). The monitoring device produced in this research works by comparing the captured image data with dataset. The captured image data are extracted into figures and form several coordinate points on the human body. Then, the system classifies the human activities into two categories, i.e., normal or littering. This device will provide an output in the form of a ewarning every time the activity of littering is detected.

Keywords: Human Activities, Littering, Image Processing, RNN.

1. INTRODUCTION

The increasing of municipal garbage production is due to population growth and accelerated urbanization [1] [2]. The lack of public awareness of waste and the absence of reprimands against people who litter causes problems, such as flooding, producing unpleasant odor, and spreading various diseases [3]. Beside two reasons above, the other cause of garbage problem is due to traditional garbage management technology has low efficiency and accuracy [4].

In general, the main factor that cause the increasing of garbage is partly due to human activity in littering. The activity itself is described by body movements or various limb positions in relation to time and gravity [5]. Nowadays, human activity recognition is an important research area in computing. It can be conducted by analyzing human behavior and human computer interaction [6]. Human activity can now be identified with sophisticated technology. Closed Circuit Television (CCTV) based surveillance has become a fundamental part of security and surveillance systems. This makes it possible to implement real time surveillance that focuses on protecting the environment, especially on littering activities [7].

The real time status of this littering identification system can help direct monitoring of littering activities which are then followed up by city authorities. In addition, the proposed device can also be used to monitor the environment, such as temperature, humidity, and air quality. These parameters can be monitored remotely via the

website. Thus, it certainly reduces the manual monitoring process. The communication in this system uses Internet of Thing (IoT) technology. IoT provides exchanges and relationships between low-energy devices and interactions via the internet [8],[9]. Besides that, Artificial Intelligence (AI) technology is also supplied in the system to identify the human activities. AI technology is artificial intelligence in computer technology based on Machine Learning, which is efficient in solving unclear problems, learning from experience, and handling uncertainty and incomplete data [10].

In this research, the author presents a device for identifying human activity in littering using webcam that can be monitored in real time. The captured images were processed by machine learning using Reccurent Neural Network (RNN) method. It is the development of the previous research [11] that used Convulutional Neural Network (CNN). The proposed research will provide a warning every time littering activity is detected. This device is expected to reduce human activities that can harm the environment, such as littering.

2. MATERIAL AND METHODS

The proposed device uses several sensors that are used as detectors. All of sendors are connected to the processors,connected via a mini PC. This system design consists of hardware design and software design.

2.1 RESEARCH STEPS

The research steps of the human activity identification system research can be seen in Figure 1.

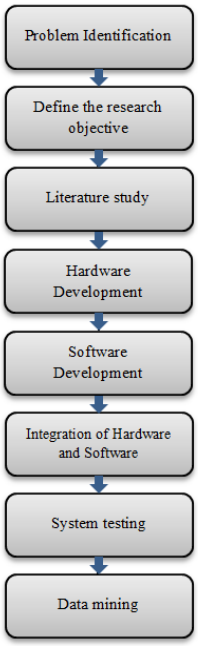

FIGURE 1. Research Steps of Human Activity Identification System

Based on Figure 1, this research is performed by starting with problem identification. It is then followed by conducting literature studies. It is useful for

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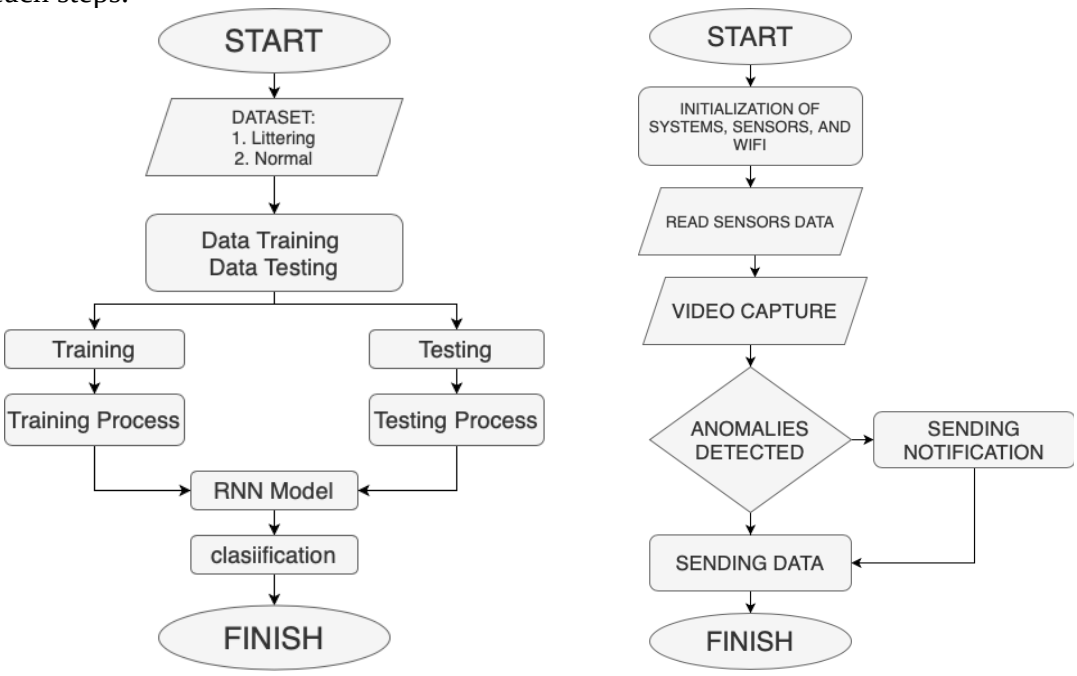
system development that bases on existing references of research that has been conducted before. After that, hardware and software design are conducted. It is then continued with integrating hardware and software. Finally, the system testing is carried out. It is then ends with the process of testing, taking data, analyzing and evaluating the the proposed device.

2.2 SYSTEM PRINCIPLES

The design of this human activity identification system has several specifications including hardware design, integrated software design. Figure 2 is a description of each steps.



(a) How the Software Works (b) How the System Works

FIGURE 2. Flowchart of How the Software Works and How the System Works

Figure 2 (a) shows how software works. The datasets were tested and trained. After processed in the processor using RNN method, the classification is established. In Figure 2 (b), the working of this system begins with a start. Then it is followed by sensor initialing, sensor readings, and capturing images. If there is a suspicious detection, then the system will send a notification and send data. Then, the work is finished.

2.3 BLOCK DIAGRAM

This system uses input sensors such as ultrasonic, DHT22, and MQ-7 sensors. All sensor components were controlled by Arduino that has been supplied by the

programs. These input data were also forwarded to a Mini PC that is connected to a camera. The Mini PC was also connected to a Power Supply which supplies the power to the system. The outputs of this system is a 20x4 LCD display. The block diagram of the littering system can be seen in Figure 3.

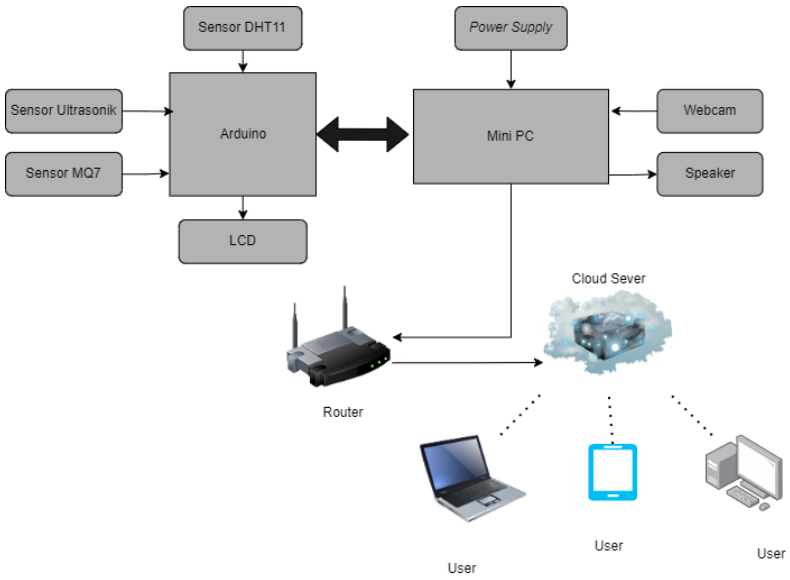


FIGURE 3. Block Diagram of Monitoring System

2.4 SYSTEM DESIGN

The human identification system in littering does not require too many components in its manufacture. Therefore, it is more practical in its use and establishment. This system is designed using a computer as the main driver and a webcam as a human activity reader or as the sensor of the device. Thus, the data can be obtained from the movement of human. In this system, phython software is used as a program development of the device. This system is very helpful, especially for the local area authorities to monitor the cleanliness of the environment. The hardware design of this system can be seen in Figure 4, while the website display can be seen in Figure 5.

FIGURE 4. Monitoring System Hardware Design

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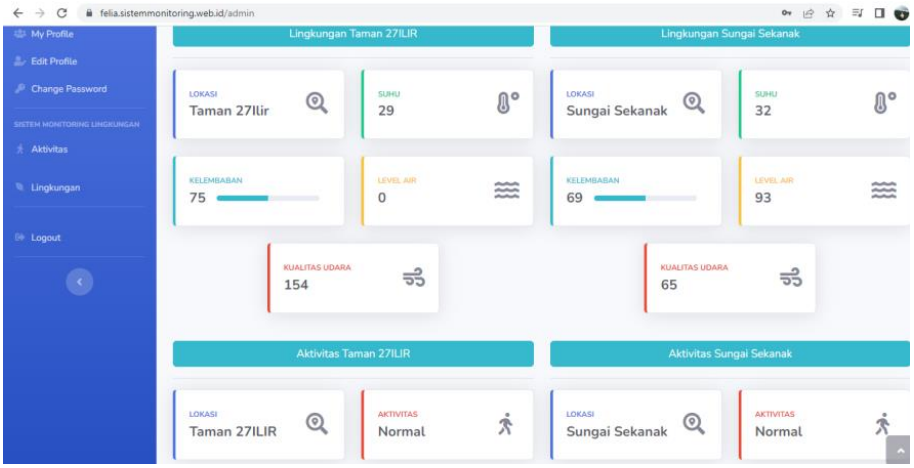

FIGURE 5. Webste Display on the System

3. RESULT AND DISCUSSION

3.1 MEASUREMENT AND TESTING STEPS

To reduce errors in measurement, it is necessary to take the following steps:

- Prepare the circuit and the device to be tested.
- Check all device components and circuits to ensure that the entire circuit is in good condition.
- Determine the number of tests to be conducted.
- Take measurements repeatedly to get more precise result.
- Record the measurement data that will serve as a reference for analysis.
- After all measurements and tests have been completed, turn off all equipment.

3.2 ACTIVITY TESTING DATA

Human activity testing in this study was carried out several times with different times and different locations. This test is conducted to obtain real-time data in the form of system identification results, whether included in human activity in throwing garbage or normal activity. In addition, this test also examines and tests the surrounding environment. Activity testing data is presented in Table 1.

3.3 WEBCAM DETECTION RESULTS

Some example results of webcam readings and detection of human activities in Sekanak riverbank and garden can be seen Figure 6 and Figure 7. The result can also be monitored by using mobile phones from further places.

TABLE 1.
Table of Activity Detection Results in Sekanak River

Location	Time	Normal Action (times)		Littering (times)	
		Real	Detected	Real	Detected
River	Morning	3	2	2	1
	Noon	14	10	21	15
	Afternoon	12	8	8	4
Garden	Morning	4	2	1	1
	Noon	5	3	-	-
	Afternoon	28	22	12	8

3.4 DEVICE ANALYSIS

Testing of the real time human activity identification device circuit was performed by preparing the sensor circuit. It was then continued with the sensor circuit connected to the mini-PC. The las was to connect overall circuit, including circuit to the speaker and fan.

The test was conducted with different locations as shown in the Table 1. In that table, the data was obtained in the form of human activity identification results, both normal activities and littering activities that were captured in real time using webcam.

The time of the testing was started from morning (08.00 – 10.00 am), afternoon (12.00 – 14.00 pm) and also afternoon (16.00 – 18.00 pm). The test was conducted for two weeks. From the test, it shows that the proposed device can well classify and identify the actions as littering or normal.

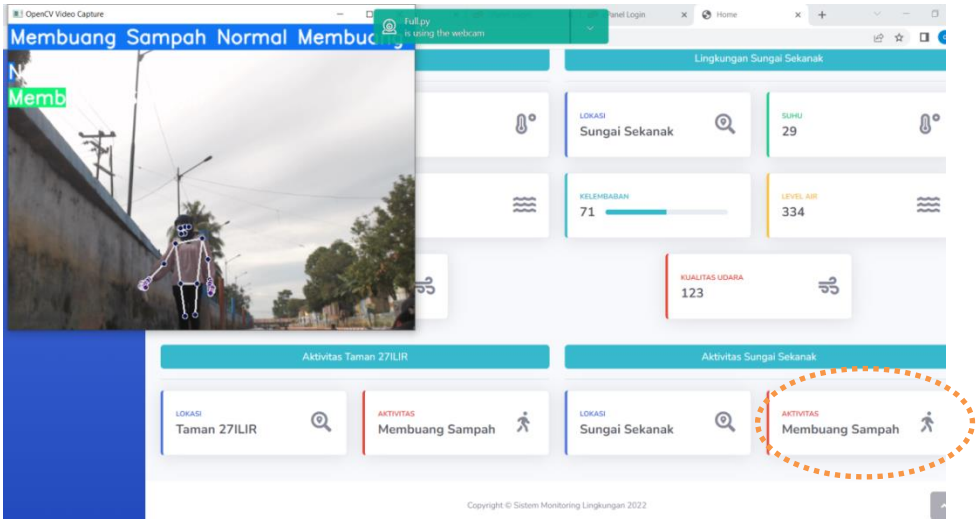

FIGURE 6. Webcam Detection Results of Littering in the River

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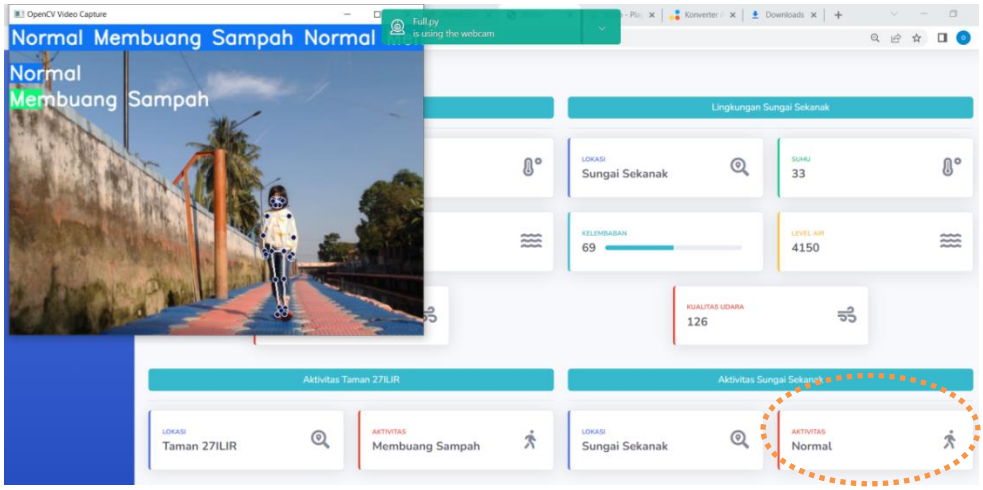

FIGURE 7. Normal Webcam Detection Results on the River

4. CONSLUSION

1. Based on the model that has been designed, the correct prediction of normal human activity and littering using RNN was 76 times.
2. The results of detecting human activity in throwing garbage in *real time* using *machine learning* can be considered to work well.
3. Fast activities or movements were difficult to be identified. It becomes an issue that should be solved in the future work.

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