International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 3 Issue 5, May – 2019, Pages: 20-25

Smart Security System Using Camera Trap Based on Background Subtraction

Sudjadi[1], Maman Somantri[2], M Arfan[3], Imam Santoso[4], Sukiswo[5], Agung Nugroho[6]
Department of Electrical Engineering,
Diponegoro University, Central Java, Indonesia
arfan.undip@gmail.com

Abstract— *In recent years efforts to increase fishery products as one of the export commodities implemented by various methods, either through intensification of cultivation or extensive by opening potential ponds. One source of such failure is the low supervision of the cultivation environment so that theft and sabotage cases increase each year. The case of theft and sabotage in aquaculture is very detrimental to farmers and increased in the period before the harvest. The crime is detrimental to the pond management. Control of ponds by placing the guards ineffective due to the location of ponds far and extreme temperatures. On the other hand, information technology is growing especially in the field of pattern recognition that can be used to detect crime in the pond. By utilizing the development of computer vision and human recognition technology by detecting motion patterns, intelligent surveillance detection systems can be implemented. In this research, the main issues inherent to camera trapping images automatic human detection on coastal aquaculture. Through several experiment the capacity of convolutional neural networks to automatize human behavior activity in camera-trap images. By using the internet of things architecture that supported the camera-trap device in the pond is expected to facilitate the manager in monitoring the condition of the ponds remotely so that the pond becomes safe. The method of recognizing the crime behavior with the background and Activity Pattern will make the introduction more precise and as expected. With the support of the internet of things architecture will help in real-time monitoring and have connectivity to several places at once.*

Keywords— internet of things ; background subtraction

1. INTRODUCTION

Fisheries development, both intensively and extensively, has the same risks, especially about failure. One source of such failure is the low supervision of the cultivation environment so that theft and sabotage cases increase each year. The case of theft and sabotage in aquaculture is very detrimental to farmers and increased in the period before the harvest. The crime is detrimental to the pond management. Control of ponds by placing the guards ineffective due to the location of ponds far and extreme temperatures. On the other hand, information technology is growing especially in the field of pattern recognition that can be used to detect crime in the pond. The development of digital technology has contributed to the field of computer vision. The ability of the camera to recognize patterns of human activity is one of the technologies that are in demand. With these technologies become part of a smart security system. [1]. Technological improvements to the introduction of patterns of human activity continue. The effect of lighting, dark conditions, the intensity of fog is a challenge in human detection by cameras. The use of digital technology has a large impact on environmental identification activities [2]. One of them is in the field of aquaculture. By using digital technology, the environmental acquisition process can be carried out in real-time and continuously. Aquaculture areas that are far from settlements can be arranged remotely so that surveillance with the camera becomes more efficient3].

Security issues are a major problem in exact cultivation. Therefore, we need a smart pattern detection system using a camera. By conducting in-depth research on convolutional neural network algorithms, automation of human behavior activities can be carried out in camera trap images [4]. The selection of objects that are well segmented between the background and motion patterns results in a precise learning algorithm to overcome the main problems in the camera trap, namely unbalanced sampling, empty frame detection, incomplete human image detection systems, and image capture far from object that causes the image to be out of focus. The selection of unbalanced objects, between the foreground and segmentation can be used to study powerful learning algorithms working in the presence of four main problems inherent in the data obtained by the camera trap: unbalanced samples, empty frames, incomplete human images, and objects too far away from focus distance [5]. Apart from these efforts, the study can only find several patterns of individual activity from less specific aspects. More accurately, what they have done is to explore human mobility patterns [3].

By using the internet of things architecture that supported the camera-trap device in the pond is expected to facilitate the manager in monitoring the condition of the ponds remotely so that the pond becomes safe. The method of recognizing the crime behavior with the Convolutional Neural Network and Activity Pattern will make the introduction more precise and as expected. With the support of the internet of things architecture will help in real-time monitoring and have connectivity to several places at once [6].

2. METHODOLOGY

2.1 Background Subtraction

The design process of Human Recognition Algorithm aims to find the right approach model based on observations that have been made into the design representation of needs. The design of the system can be a model and also a visual design that aims to simplify the process of implementation on the system.

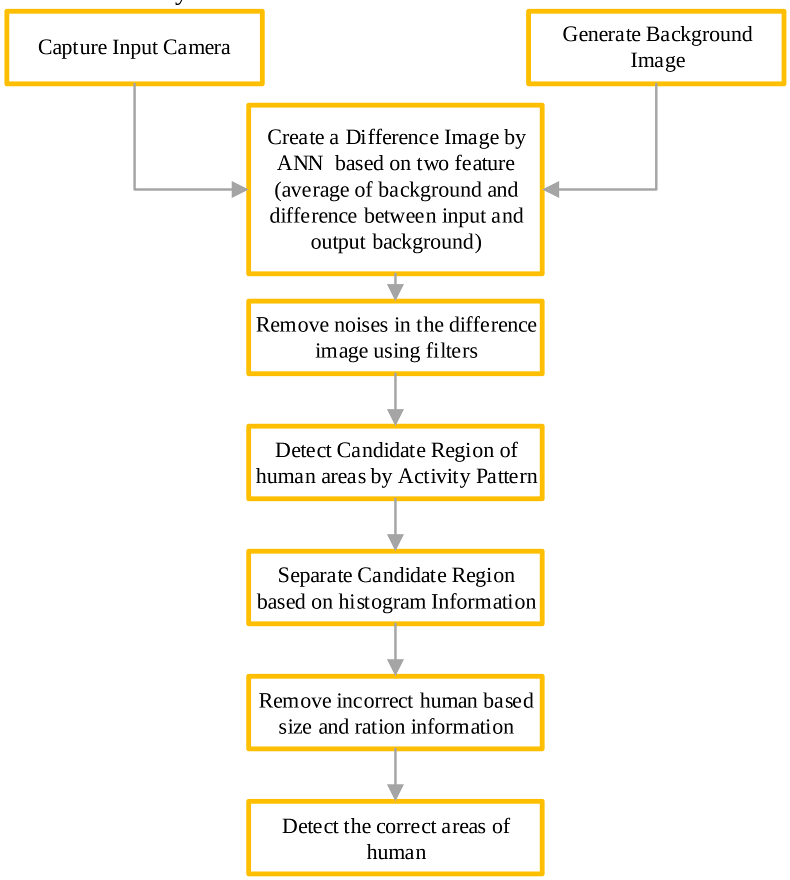


Figure 1: Background Subtraction

In producing a background image. Images are created by a filtering mechanism that allows non-background areas to be removed. Then the background image is taken and the difference in image (pixel) obtained from the background and input in the form of an image. Extraction The threshold in the candidate area is determined adaptively using a pattern of human activity by using the image brightness feature on the background which is influenced by image input [7].

The next step is to detect the area of human existence. By using size filtering and morphological operations a non-human area can be obtained which can be removed by a filter mechanism. Filters are based on size, area ratio, vertical and horizontal histograms and separate candidate areas. After removing the wrong human area based on normal human size and clarity of background and area contrast then proceed to detect the correct human area. Unprocessed areas are then combined based on the camera's focal distance between the object and the direction of the camera. Finally, it produces a preset human area.

2.2 Activity Pattern

The pattern of human activities is obtained from two types of distribution, namely distribution in the conditions of residence and distribution of semantics which are also related to the set of residence. The two types of distributions adapt to living conditions referring to the type of place, which is illustrated by the distribution of residence.[3]

The formula P (p | z) to calculate the distribution of residence under a set of dwellings (categories) z. Distribution in the residence set, P (z) because it can describe the spatiotemporal pattern of a type of activity. Semantic pattern recognition is determined by distribution on the topic [3]. Using P (s) to represent related semantic patterns and finally show the motivation behind the spatiotemporal pattern. After being given a topic, P (w | s) as a distribution of words used to describe the topic about what was discussed. Therefore, the pattern of human activity D can be defined by:

D = {P(z),P(s)} (1)

In the set model the dwellings are tripled and semantic words. The pattern of human activity consists of spatiotemporal patterns and semantic patterns. While the temporal spatial pattern, from top to bottom, can be filled with three sets of residence with different possibilities. Appearance sets vary for each set of residence [3]. Rough description of the process. In each activity pattern, the possibilities and place of residence can be seen in the activity pattern m are:

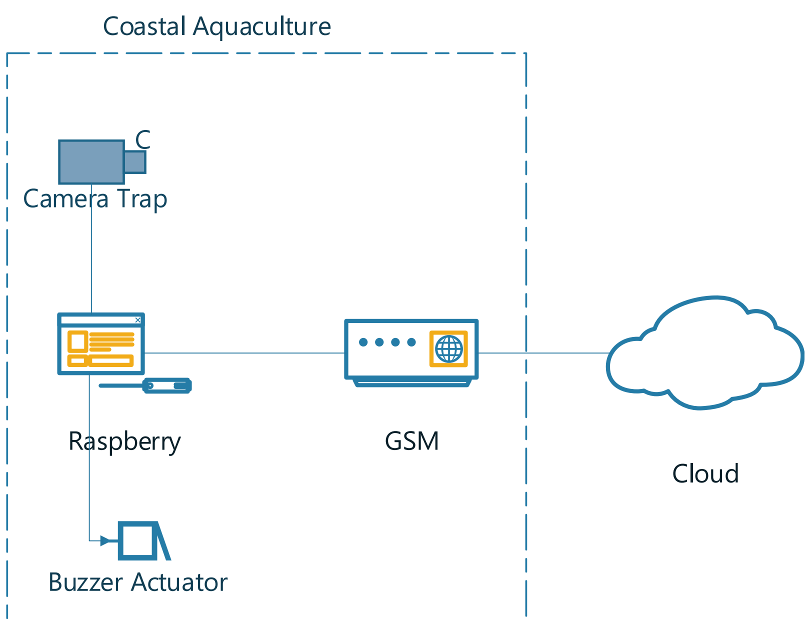
$$P(Pi|m) = \sum_{j=1}^{l} P(Pi|Zi = j)P(Zi = j|m) \quad (2)$$

$$P(Wi|m) = \sum_{j=1}^{k} P(Wi|Si = j)P(Si = j|m) \quad (3)$$

from the formula above it can be seen that Zi is a variable that shows the set of residences from which the residence is used, si is a variable that shows the topic from which word h is used.

2.3 System Design

The design of infrastructure aims to create an implementation model that suits the needs and easily accessed whenever and wherever. System architecture design aims to identify the direction of design and constraints during implementation. The location of the study was carried out in the coastal area so that precise results of research could be obtained. With this approach, research is expected to achieve satisfactory results. Following is the design of the camera trap in the coastal region.



3

4 **Figure 2:** Camera Trap

In the design, a PIR sensor is used as a sensor to detect the presence of humans by using a camera and triggering image recording. By including a microwave as a sensor to confirm which is at a certain frequency and range. The equipment is stored in a place that can withstand extreme weather so it is flexible to use. To reduce the performance of the feeding sensor, the Raspberry Pi model B has a 700 MHz clock speed and 17 Input / Output pins to connect and control other sensors and peripherals [8]. The camera will connect to Raspberry Pi in a dedicated manner.

International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 3 Issue 5, May – 2019, Pages: 20-25

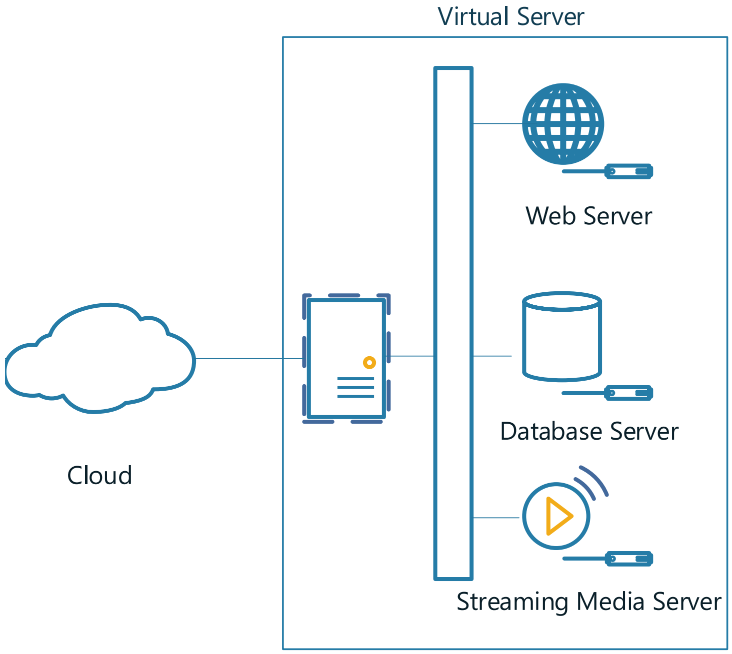


Figure 3: Cloud Server

Camera Serial Interface (CSI) and Universal Serial Bus (USB), making it easier to install other modules with the USB interface. By adding a Real Time Clock (RTC) for time consistency so that when the power breaks, the system can be activated or deactivated at the pre-programmed time. The use of a Linux-based operating system and open source software to control the Smart Security System, so that images and outputs of programs taken can be stored through cloud services. With Cloud the security system is increasingly reliable to avoid sabotage.

3. Result

The results of this study are camera traps equipped with human pattern recognition features. Several scenarios are used to measure the reliability of this technology. This research adapts to coastal conditions. By using an approach using human motion tests based on patterns and distances, some results will be obtained from the previously compiled scenario. The preliminary study conducted by collecting information with observations about the theft patterns connected to cloud services. Information digging done by consultation with pond management that will conduct monitoring and supporting information about thief behavior in doing the action. With the study of opportunities in the area of fishery, cultivation will be obtained formulation of the conditions and needs of the system to build.

The testing process is carried out until the model is obtained according to the system character. Model testing is done by an experimental approach to several models described in the design. The system test plan has two methods, error test and function test. From the results of testing carried out with distances of 5m, 10m, 15m, 20m, and 25m, the results obtained in figure 9. In the results of these tests, the camera can function at night with the help of infrared.

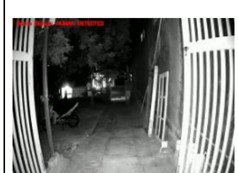
Table 1: Image Recognize

Distc	**Image**	
5m	 frame 3	 frame 98

10m	 frame 4	 frame 105
15m	 frame 7	 Frame 100
20m	 frame 3	 frame 105
25m	 frame 5	 frame 115

For testing the delivery of notifications in the form of e-mail, the results obtained are in Table I where at a distance of 5m, 10m, and 15m, the algorithm runs well and notifications are sent when the object appears. While at the distance of 20m and 25m, the program does not detect object movements and notifications are not executed.

Table 2: Result

Distc.	Notification Image	
5m		
10m		

Distc.	Notification Image	
15m		
20m	Not detected	Not detected
25m	Not detected	Not detected

In the future, the limitations of Camera Trap in detecting movements quickly based on patterns of human activity. With digital technology, each device is able to communicate with other devices. The results of communication between devices are then processed into information that can improve the quality of human life. The application of a camera system with the introduction of human activity features is expected to provide precise supervision and reports can be provided in real-time with the help of machines that can be accessed remotely.

4. Conclusion

In this study, image recognition using the background subtraction method can reach a distance of 15 meters. In further research, a number of motion patterns will be developed to perfect the camera trap based on activity pattern. Thief motion pattern training will be given to the engine and processed through a cloud machine

5. References

[1] S. Masood, A. Rai, A. Aggarwal, M. N. Doja, and M. Ahmad, "Detecting distraction of drivers using Convolutional Neural Network," *Pattern Recognit. Lett.*, vol. 0, pp. 1–7, 2018.

[2] S. Nazir *et al.*, "WiseEye: Next generation expandable and programmable camera trap platform for wildlife research," *PLoS One*, vol. 12, no. 1, pp. 1–15, 2017.

[3] W. Huang and S. Li, "Understanding human activity patterns based on space-time-semantics," *ISPRS J. Photogramm. Remote Sens.*, vol. 121, pp. 1–10, 2016.

[4] V. Gajjar, A. Gurnani, and Y. Khandhediya, "Human Detection and Tracking for Video Surveillance A Cognitive Science Approach," *arXiv1709.00726v1 [cs]*, pp. 2805–2809, 2017.

[5] A. Gomez Villa, A. Salazar, and F. Vargas, "Towards automatic wild animal monitoring: Identification of animal species in camera-trap images using very deep convolutional neural networks," *Ecol. Inform.*, vol. 41, no. November 2016, pp. 24–32, 2017.

[6] M. Zillur Rahman *et al.*, "Water quality assessment of a shrimp farm: A study in a salinity prone area of Bangladesh," *Int. J. Fish. Aquat. Stud. IJFAS*, vol. 2, no. 25, pp. 9–19, 2015.

[7] E. A. Smirnov, D. M. Timoshenko, and S. N. Andrianov, "Comparison of Regularization Methods for ImageNet Classification with Deep Convolutional Neural Networks," *AASRI Procedia*, vol. 6, pp. 89–94, 2014.

[8] T. N. A. M. Pham, M. Tsai, and D. U. C. B. Nguyen, "A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies," pp. 1581–1591, 2015.