Geofencing technology implementation for pet tracker using Arduino based on Android

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Geofencing technology implementation for pet tracker using Arduino based on Android

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Abstract. The risk of losing pets, especially pets without a leash, usually occurs because animals get lost or stolen by irresponsible people. Owners can look for themselves to the nearest environment, ask people around, to make announcement posters at strategic places. Searching in this way takes a lot of time and effort and the pets you are looking for are not necessarily found immediately. So we need an application and an animal tracking device in order to find out the location of the animal's whereabouts, one of which is by using a tracking device that utilizes the Global Positioning System (GPS). This study aims to implement geofencing technology for pet tracking using Android-based Arduino. The application development stage includes analysis, system design, implementation, and testing. This program is implemented using U-Blox Neo 6M to track location with GPS network, SIM800L is used to send coordinate point data to trackers using GPRS network, and Arduino pro mini to manage input and output processes from the system. The test results show the tools and applications can run well. The android based pet tracker that is made can receive notification when a pet goes out of a predefined geofence limit.

1. Introduction

Taking care of animals is a big responsibility, including for the most experienced animal lover. When someone decides to have a pet, there are many things to consider before raising the animal. Because when people decide to keep an animal, that person has a commitment to take care of the animal. Before maintaining, there are several factors that need to be considered, one of which is the safety of pets.

A person often loses his pet and will feel anxious when the animal does not return. The risk of losing pets, especially pets without a leash, usually occurs because animals get lost or stolen by irresponsible people. If lost, the owner can look for himself to the nearest environment, ask people around, and make announcement posters at strategic places. Searching in this way takes a lot of time and effort and the pets you are looking for are not necessarily found immediately. Therefore, it is necessary to make an animal tracker in order to find out the location of the animal, one of which is by using a tracking device that utilizes the Global Positioning System (GPS) [1], [2].

GPS is a tool that will help to find out your current position [3]. GPS works by transmitting signals from satellites to GPS-equipped devices [4]. Technology development is so fast nowadays. Technological developments in this context are all things that have a relationship with humans and make it easy to produce and / or use something [5]. So that this causes the development of the use of technology in everyday life, especially in the use of smart applications [6]. The number of active Android users in 2019 is 2.5 billion active users. Because Android smartphones are equipped with various important

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features, one of which is the GPS (Global Positioning System) feature which can be used to monitor the presence of pets [4], [7]. By using GPS and the use of geofencing, it will help to find out the position of the pet when it comes out of a predetermined geofence area [5], [8]. Geofencing is an innovative technology that utilizes real-world geographic coordinates by defining virtual boundaries or parameters. Geofencing itself allows one to remotely monitor a certain geographic area [9]. Geofencing is a virtual barrier that can be used to monitor the movement of an object in a certain area, so that when the object crosses a predetermined geofence, the system will send a notification to the observer [10]. The geofencing system is a system that can be used to monitor the location of an object and will provide reports or notifications when the object exits or enters an area that has been geofenced by monitors [11], [12].

Based on the description above, the author will build an application for implementing geofencing technology for pet trackers using Android-based Arduino which utilizes the Global Positioning System (GPS) in an android smartphone. With the GPS and geofencing system, users can receive notifications to the user's smartphone when their pet is out of the geofence limit. The purpose of this application is to assist pet owners in monitoring their pets when their animals are lost or do not return home.

2. Geofencing Methods

2.1. Geofencing

According to Muriach geofencing is a technique that allows applications to provide information in a more precise way, at the right time and in the right place. This geofencing technique requires 2 main physical components, namely a physical area bounded by digital fences and a device capable of receiving the information provided through the geofencing technique. And when the device passes through one of the geofence areas (entering or leaving the area), there will be an alert or notification sent to the device.

2.2. Global Positioning System (GPS)

GPS is a system for determining the location on the earth's surface with the help of satellite signal synchronization. This system uses 24 satellites that send microwave signals to earth. This signal is received by the receiver on the surface and is used to determine the location, speed, direction and time. Systems similar to GPS include Russian GLONASS, European Union Galileo and India's IRNSS.

2.3. Android

Android is a mobile operating system that grows in the middle of other operating systems that are developing today. Other operating systems such as Windows Mobile, i-Phone OS, Symbian and many more also offer a wealth of content and optimality running on existing hardware devices. However, this existing operating system runs by prioritizing core applications that are built on their own without seeing the considerable potential of third-party applications. Therefore, there are limitations to the distribution of third-party applications for their platform.

3. Research Method

3.1 Research Object

The object of this research was carried out at Sekar Bakung Residence Yogyakarta. Sekar Bakung Residence Yogyakarta housing located on Jl. West Imogiri, Semail, Bangunharjo, Kec. Sewon, Bantul, Yogyakarta 55188. In accordance with the title compiled by the author, namely regarding the implementation of geofencing technology for pet trackers using Android-based Arduino, this research will design and build a tool and application that can help pet owners in monitoring pets when they are

lost or do not return home. The application can receive notifications when a pet goes outside a predefined geofence limit.

3.2 Flowchart
Flowchart shows the process flow in the system. The design of the flowchart in the design of the tool to be made can be seen in Figure 1.
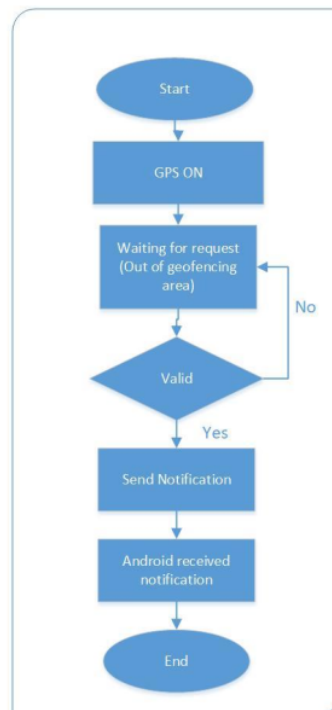

Figure 1. Flowchart

Figure 1 above illustrates the process of how a pet tracking device works. When the tool is used, the GPS must first be in the ON position, the sensor on the SIM800L Module starts to collect data. After that the data will be sent to Arduino then the output data is processed and displayed on the Android application in the form of the pet's location. If the pet leaves the geofencing area, then the android application displays a notification that the animal is outside the geofencing area.

3.3 System Design
The following is a block diagram of the tools used to monitor the presence of pets. The tool consists of a series of Arduino, Sim 800L, GPS Antenna, and Battery. Figure 2 is a picture of the block diagram of the tool to be assembled:
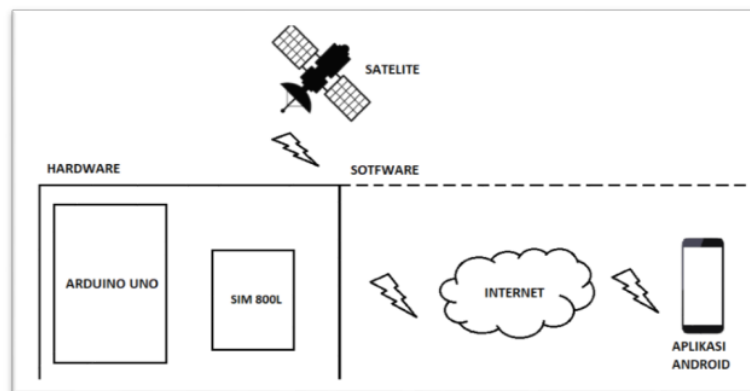
Figure 2. System Design

Figure 2 shows a system design built by hardware consisting of an Arduino, a GPS and GPRS SIM800L module placed on a pet, an Android-based application software installed on the pet owner's cellphone. The function of Arduino is as a tool for controlling electronic components connected to it, the GPS Module as a receiver of location data (latitude and longitude), the GPRS Module for connection to the internet. Android application as notification recipient when pet comes out of the geofencing area.

3.4 Tool Design

The display of this pet tracker is a dog collar. On the necklace there is a box containing a series of Arduino, SIM800L, GPS antenna, and battery. The design of the tool display is shown in the Figure 3.

Figure 3. Pet Tracker Design

3.5 Hardware

Hardware assembly consists of several circuit blocks that have their respective functions arranged in such a way, so that a complete system is formed and can work accordingly which are expected. The following are the components used in the process hardware designing,

    a) GSM modul SIM800L
    b) Arduino Pro mini
    c) GPS Modul Ublox Neo 6m
    d) Circuit Relays
    e) Power supply circuit
    f) and other supporting components.

3.6 Software Design

This monitor display is used as a human interface to make it easier for users to monitor their pets. The notification page on the android smartphone displays a notification when a pet leaves the geofencing area. The view position button is used to determine the pet's current position. The position page is displayed as a map with GPS. Figure 4 shows a notification page design on the android application that was built.

Figure 4. Notification Form Design

4. Research Design

The implementation of geofencing technology has been successfully carried out in making pet tracking tools and applications using Android-based Arduino. The tools and applications created can help pet owners in monitoring their pets when their animals are lost or do not return home. The application can receive a notification when a pet is detected when it is out of a predefined geofence limit. The hardware used is the Arduino pro mini microcontroller, SIM800L GSM module, GPS UBLOX NEO 6. The display of the animal tracking device can be seen in Figure 5.

Figure 5. Animal Tracking Devices

From the design of the animal tracking device that has been prepared beforehand, the final results of making the tool using the Arduino Pro mini microcontroller look like in the picture above. The animal tracking device above uses a GSM SIM800L module and a GPS Ublox Neo 6. The physical design of

the device consists of input, process and output. The input consists of a GSM sensor SIM800L module and a GPS Ublox Neo 6 as a location tracker using latitude and longitude for data sent to the server, the process uses Arduino pro mini as a data processor from the GSM module and GPS and output uses an android smartphone to display notifications when animals exit the geofencing area that has been previously set.

Figure 6. Design of the animal tracking tool app

The login form page, as seen in Figure 6, is a page used to display the user login form on the android application. The user enters the username and password to enter the application.

Figure 7. Main Menu Page

The main menu page, as seen in Figure 7, is the page that was first displayed when the user successfully logged in. There are three main menus that can be accessed by users, including notification menu, report and logout. A notification page is a page that shows notifications when a pet is tracked out of a designated area. Users can find out the location of animals by opening the map shown in the app.
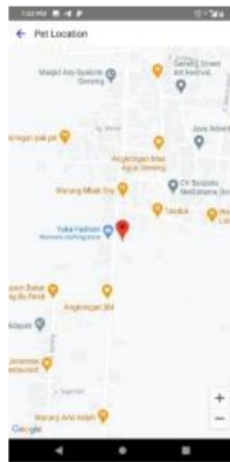
Figure 8. Map Page

A report page is a page used to display reports when a pet is tracked out of the area, based on map, as shown in Figure 8. The report is displayed in table form. A web login page is a page used by admins to sign in. This form serves to enter your username and password. Then the system will check if the username and password entered match the database.
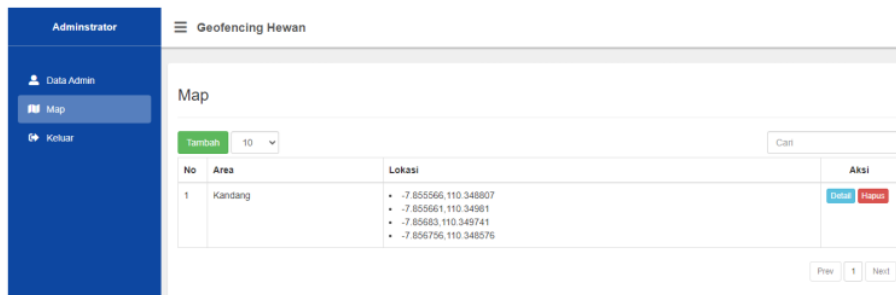

Figure 9. Display of Geofencing Area

A geofencing page in Figure 9 is a page used to display a table of geofencing areas created by an admin. Location data in the form of latitude and longitude is displayed in the form of a table. A folder detail page is a page used to manage geofencing areas. Admins can delete and add geofencing area data by creating a fence on the folder.

5. Results and Discussion
The implementation of geofencing technology has been successfully carried out in making pet tracking tools and applications using Android-based Arduino. The tools and applications created can help pet owners monitor their pets when their animals are lost or do not return home. The application can receive a notification when a pet is detected when it is out of a predefined geofence limit. In designing this program using U-Blox Neo 6M to track location with GPS network, SIM800L is used to send coordinate point data to trackers with GPRS network, Arduino pro mini to manage input and output processes from

the system, and battery as the main resource used tool. Trackers can find out where the user's pet is. The hardware used is the Arduino pro mini microcontroller, SIM800L GSM module, GPS UBLOX NEO 6.

Performance testing, at this stage is carried out using samples of various distances, then the results of the point readings (latitude and longitude of the location) are stored according to the data base that has been created in the program. Performance testing is carried out using 10 samples of different distance data. The results of testing a pet location detector shown in Table 1.

Table 1. Performance Testing Results

Attempt	Distance	Status
1.	5 meters	Detected
2.	10 meters	Detected
3.	15 meters	Detected
4.	20 meters	Detected
5.	25 meters	Detected
6.	30 meters	Detected
7.	35 meters	Detected
8.	40 meters	Detected
9.	45 meters	Detected
10.	50 meters	Detected

Based on 10 sampling distances that have been tested, there is not one point that is not detected. So it can be concluded that the tool has functioned well and can be implemented in a pet detector. The animal tracking system was tested by 30 respondents, and then filled out a questionnaire about the system performance. The results of questionnaire data processing about system performance are shown in Figures 10.
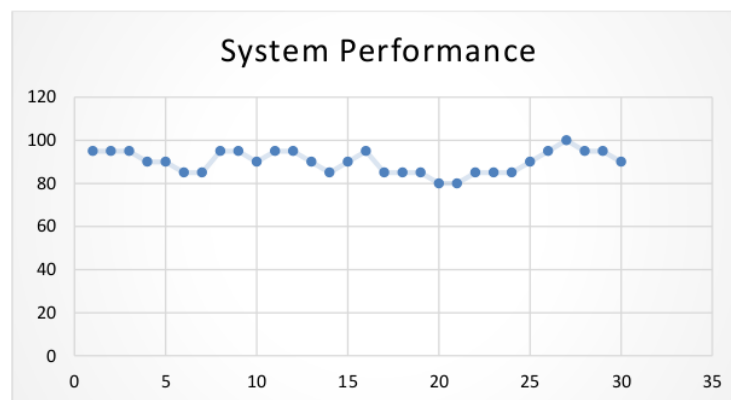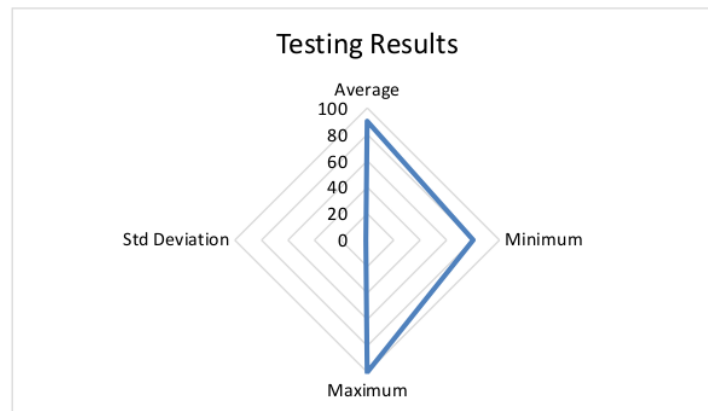

Figure 10. System Performance

Figure 11. Testing Results

Figure 11 shows the testing results with the average value is 90, the minimum value is 80, the maximum value is 100 and the standard deviation is 1.050.

6. Conclusion

The pet tracking device that consists of SIM800L GSM / GPRS and GPS Ublox Neo 6 can be used to detect the location of the pet, and the Arduino pro mini microcontroller which functions as a system control and data processor can work properly. The pet tracking device has a system that automatically sends location data using the GPS Ublox Neo 6 then the results of the location detection are displayed on the smartphone. Users can create fences in the form of geofencing areas to limit safe areas for their pets. Applications can provide information when pets leave the geofencing area via a smartphone so that pet owners can monitor the whereabouts of the pet's location. User can manage the fence of the desired location according to the pet owner's requirements.

In this study there are still several lacks, namely the geofencing area cannot be edited, it can only be added and deleted from the database, the geofencing area can only be edited via a web page, cannot be edited via the Android application, and the battery used in the device cannot be charged. through the tool so that it must be removed first when the battery runs out. It can be processed by researcher in the future.

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