RESPONSIVENESS GPS DATA CAPTURE AR DRONE 2.0 AGAINST FACTOR WEATHER, TEMPERATURE AND WIND SPEED

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RESPONSIVENESS GPS DATA CAPTURE AR DRONE 2.0 AGAINST FACTOR WEATHER, TEMPERATURE AND WIND SPEED

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ABSTRACT

AR Drone 2.0 is a miniature unmanned aircraft equipped with pressure sensors that can make drone steady vertically with a certain height. Pressure sensor uses ultrasound sensors to stabilize drone at an altitude of less than 6 meters. IMU sensor consists of a 3-axis gyro sensor, 3-axis accelerometer sensor, 3-axis magnetometer sensor. AR Drone 2.0 is also equipped with HD resolution camera with 30 fps 720fpp installed onboard. The unavailability locator, become an extension features that were examined in previous research [5]. The use of GPS is the basic idea of research that trigger the appearance of a challenge on the integration GPS with the CPU on the AR Drone, and wireless communications to transfer the data location to the base station. The challenges of GPS extension is realized through the integration of microcontroller Arduino Pro Mini, U-blox GPS modules NEO 6-M, the radio module APC220. Furthermore, in this research, the design of the extension of the GPS module will be tested the level of responsiveness against the weather, temperature and wind speed.

Keywords: AR Drone 2.0, GPS module extension, responsiveness.

INTRODUCTION

AR Drone 2.0 is a miniature unmanned aircraft, includes the type of a quad-copter multi-rotor category that has 4 motors which used to rotate the propeller at each end of the plane in order to produce lift. AR Drone 2.0 is equipped with new sensors such as pressure sensors that collaborated with ultrasound sensors that can make drone steady vertically to a certain height, for example balance the drone at a height of less than 6 meters. In addition to the sensors that have been mentioned, there is also an IMU sensor that consists of a 3-axis gyro sensor, 3-axis accelerometer sensor, 3-axis magnetometer sensor. AR Drone 2.0 is also equipped with 720p HD resolution camera with 30 fps which is installed onboard. AR Drone 2.0 version can also be controlled using a smartphone based on Android and iOS, and also has an open-source API that can be developed or improved. [1]

AR-Drone is no longer used as entertainment, but can be used and exploited in other fields, such as military, mapping, research, photography and others. AR Drone can be controlled automatically, so that it can be used in sites which are not affordable by human beings. Besides that, the AR Drone can also be used to complete dangerous missions in the remote area. So that it can be also minimizing the possibility of fatalities and injured. Based on the description above, AR-Drone start to be implemented to help searching for victims of the disaster and monitoring the disaster area which are not be reached by human power or rough terrain vehicles.

Monitoring disaster areas using drones are also often affected by some constraints. Some constraints that usually emerge are the difficulty of signal reception, disconnected and delay of delivery streaming video images, and also the difficulty of positioning and location coordinates of disaster area. GPS installation research and implementation of video streaming have been implemented in the previous studies [5], [11]. This study will assess the responsiveness of drones to the location indicated by the GPS against weather factors, temperature, and wind speed.

RELATED WORK

Extension module GPS AR Drone 2.0 is the basic idea of this research in order to complete the bookmark feature locations that serve to enhance the drone control aspects, particularly when drones cannot be seen by controllers. Research which have been studied is how the tracking system GPS module with monitoring via Google map [2], The implementation of GPS in the vehicle and lock the vehicle [3] and study the NMEA data conversion and SIRF [4]. In addition, learn the topic of research on the development of GPS up to 10 years in the future [9] and some research on the localization and GPS timing synchronization using a smartphone [10]. This research is also the development of the GPS information delivery system on the AR Drone 2.0 [5].

PROPOSED WORK

After doing embedding GPS module extension on AR Drone 2.0 [5], this research then assess the responsiveness of drones to the location indicated by the GPS against weather factors, temperature, and wind speed. The accuracy of the location indicated by the GPS will be compared with location indicators on Google Maps.

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Components

The detailed specifications of the AR Drone 2.0 [6]:

- GHz 32 bit ARM Cortex A8 processor with 800MHz video DSP TMS320DMC64x.
- Linux 2.6.32.
- 1 Gbit DDR2 RAM at 200MHz.
- USB 2.0 high speed for extensions.
- Wi-Fi b,g,n.
- IMU Sensor (3-axis gyroscope 2000°/second precision, 3-axis accelerometer ±50mg precision, 3-axis magnetometer 6° precision).
- Preassure sensor ±10 Pa precision.
- HD 720p Camera onboard. [6]

Figure-1. Component AR Drone 2.0.

Extension module GPS AR Drone 2.0 in this research, utilizes a number of supporting components as follows:

Arduino

Arduino is an open source microcontroller developed by the Arduino company in Italy. Arduino has input and output (I / O) that can be implemented using the programming language. (www.processing.org). [7]

Arduino Pro Mini

Arduino Pro Mini is a microcontroller Arduino which has a small size and the price is quite cheap, so it is suitable for small appliances that require a microcontroller. [8]

Arduino IDE

Arduino IDE (Integrated Development Environment) is Arduino microcontroller programming software. Inside Arduino IDE applications, there has been a GCC-based compiler. Arduino IDE using the C programming language and an open source library, so that anyone can create their own library as appropriate

Global Positioning System (GPS)

GPS (Global Positioning System) is a satellite navigation system that functions to determine a position on the earth. GPS module used in this study are U-Blox GPS NEO-6M. [12]

NMEA Protocol

NMEA (National Marine Electronics Association) protocol is a standard protocol of data in the navigation system. NMEA protocol is used on the GPS system in the transmission of data from the satellite. NMEA has some packet header data that having different information functions. Packet header data which is used in this research are GGA, GLL and RMC. The data package indicates the location of latitude, longitude, altitude, compass directions and timing.

USB to TTL CP2102

This tool has functions as a media or tools to communicate with the AR Drone 2.0, serially. This tools using the differential voltage levels which are compatible with TTL signal. Voltage level used is equal to 5V.

Radio Frequency APC220

Radio Frequency works as a sender and receiver GPS data wirelessly, so that the GPS data can be processed by a desktop-based application.

Design

Design Schematic and PCB Board

Board schematic and PCB design is designed to connect components such as Arduino, GPS module, APC 200 and USB to TTL. The application used to create the design schematic and PCB Board is EAGLE CAD version 6.2.0

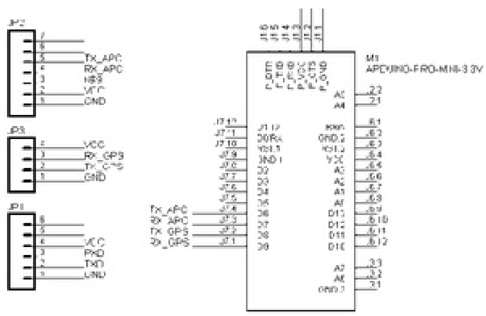

Figure-2. Schematic Sistem GPS [5].

Diagram Block and Flowchart System

The overall design of block diagram and flowchart of the research can be described as follows.

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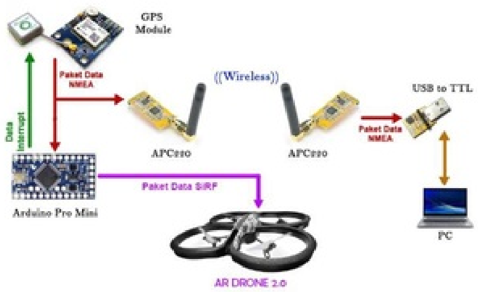

Figure-3. Diagram Block System [5].

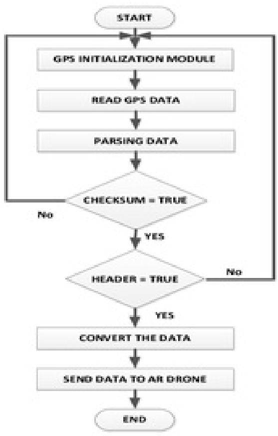

Figure-4. Flowchart System.

In Figures 3 and 4, can be explained that the user perform GPS initialization module to send the position where the drone will be placed. Then, the system reads the GPS data. GPS data is then parsed and examined according to the header to determine the longitude and latitude position. If the header and the checksum = TRUE, then the data GPS will be conversion. The result of the conversion data then sent to the drone.

Parsing Data

Parsing data is a method that is used to read data from a protocol packet NMEA. Data parsed into three parts:

- Header, as a command or address indicator of the data.
- Data, as a value that has information which will be process and give an understandable information
- Checksum is ending part of a packet data which will indicate the completeness of data.

A data package is valid if all three components fulfilled. So that can minimize errors of a data processing.

Implementation

Installation

Each component is designed and implemented on a PCB board that has been printed, according to the PCB design and block diagram. The results of the installation and the arrangement of components can be seen in Figure-5.

Figure-5. Installation of Component [5].

GPS module is not installed on the PCB Board. This is due to the AR Drone space which is very limited area to install and also to minimize interference noise on the drone control signals. It can be shown on Figure-6, PCB Board placed on the drone near from drone's camera.

Figure-6. Installation GPS AR Drone 2.0 [5].

Frequency Configuration and APC 2200

APC 220 is installed by using RF-Magic application for APC 22x. APC220 connected on port COM1 to COM4. It can be shown at Figure-7, about configuration network of APC 220 like frequency setting, baudrate, Maximum power, Net ID and Node ID. It should be noted that the Net ID must be the same between interconnected components.

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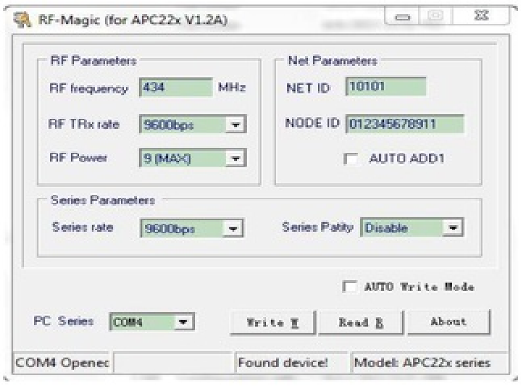

Figure-7. APC220 configuration [5].

Scenario Test

GPS extension test with the following scenarios:

- AR Drone 2.0 tested in the area of Faculty of Applied Science School of Telkom University and Batununggal Residence area Bandung,

- When the drones flying at an altitude about 100 m, GPS extensions on drone began a GPS satellite sensing. Then, GPS module sends the data of Altitude, Latitude, and Longitude of drone to PC base station via radio frequency.

Based on the above scenario, the test results will be noted based on the difference in weather, temperature and wind speed. The weather is classified into clear, partly cloudy (the condition when bright sunny day with cloudy), cloudy (heavy cloudy), rainy, and mostly cloudy (the condition after the rain falls). The temperature measured at 16^{0}C range up to 24^{0}C. The wind speeds are grouped within the 0 to <5 mph, 5 to <10 mph, and> = 10 mph. Classification of the weather conditions, temperature and wind speed above, were taken based on the measurement conditions on the test site, which is carried out in the period 2 to May 7, 2015. This test was taken about 45 attempts.

These three parameters then assessed refers to:

- Responsiveness GPS are expressed in the length of time required by the GPS to receive signals from the satellite to the PC base station receives location data.

- The accuracy of the GPS location data compared to the location data from Google Maps.

Test Result

Based on test scenarios above, the results of testing the responsiveness of GPS extension on the AR Drone 2.0 can be described as follows:

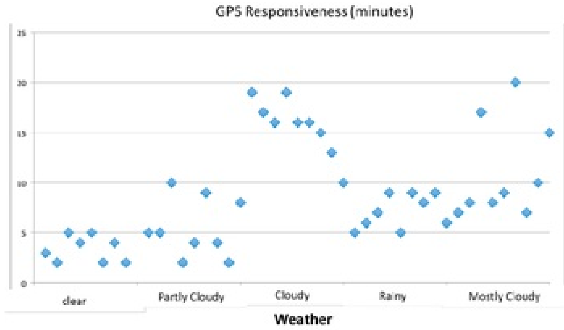

Figure-8. The Effect of the Weather on Responsiveness of the GPS on AR Drone 2.0.

Based on the Figure-8, it can be concluded that on increasingly clearly weather conditions, the level of responsiveness of GPS extension on the AR Drone 2.0 is getting better.

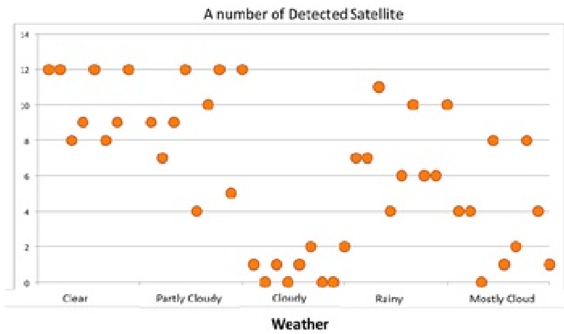

Figure-9. The effects of the weather on the number of Detected GPS Satellites.

Based on the Figure-9, it can be concluded that on cloudy weather conditions can impede the ability to detect the GPS satellites.

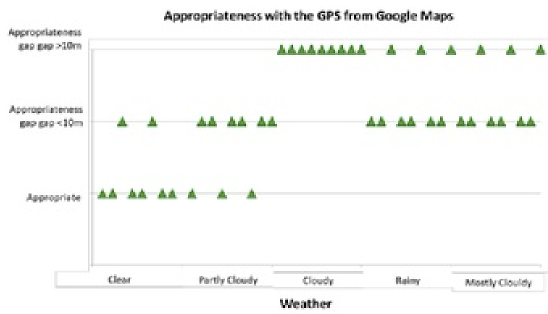

Figure-10. The Effect of the Weather on Appropriateness with the GPS from Google Maps.

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Based on the Figure-10, it can be concluded that more clearly weather, the result of the capture of the location by GPS AR Drone 2.0 extension will be appropriate with Google Maps.

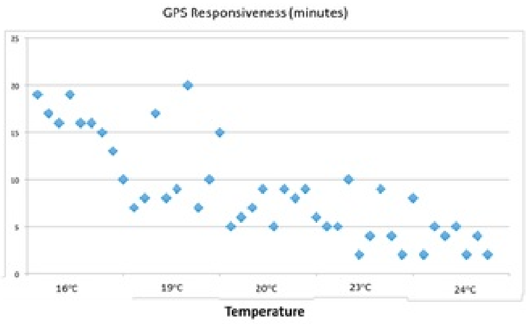

Figure-11. The effect of temperature on the responsiveness of the GPS on the AR Drone 2.0.

Based on the Figure-11, it can be concluded that the warmer temperatures, the level of responsiveness of GPS extension in the AR Drone 2.0 is getting better. But in this case, we need to pay attention to the temperature range at the time of testing that only ranges in the range of 16oC to 24oC. The Results of the analysis in this case is not applicable generic so that it cannot be guaranteed at temperatures of more than 24°C or below 16°C.

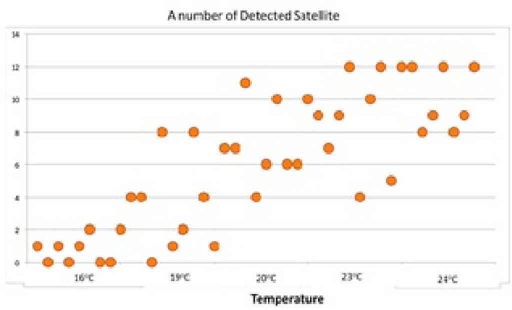

Figure-12. The Effect of Temperature on the Number of Detected GPS Satellites.

Based on the Figure-12, it can be concluded that at warmer temperatures, the number of detected GPS satellite is getting better. But in this case, we need to pay attention to the temperature range at the time of testing that only ranges in the range of 16°C to 24°C. The Results of the analysis in this case is not applicable generic, so that it cannot be guaranteed at temperatures of more than 24°C or below 16°C.

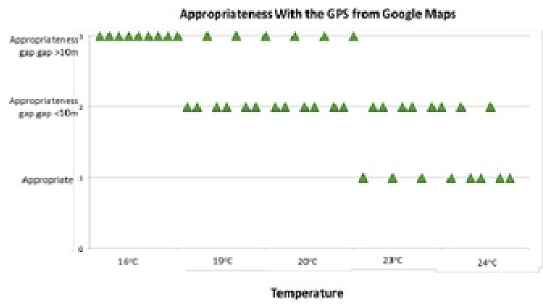

Figure-13. The Effect of Temperature on Appropriateness with the GPS from Google Maps.

Based on the Figure-13, it can be concluded that at warmer temperatures, then capture results location by GPS AR Drone 2.0 extension will be appropriate with Google Maps. But in this case, we need to pay attention to the temperature range at the time of testing that only ranges in the range of 16°C to 24°C. The Results of the analysis in this case is not applicable generic so that it cannot be guaranteed at temperatures of more than 24°C or below 16°C.

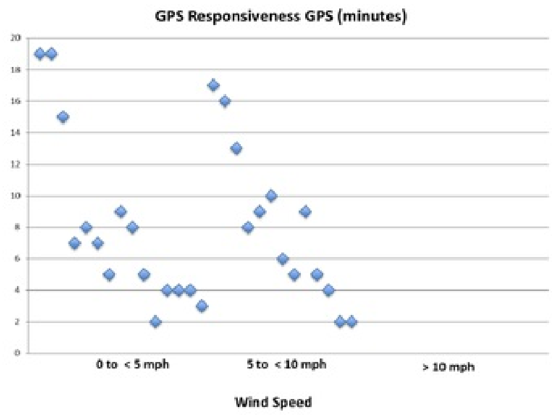

Figure-14. The effect of the wind speed on responsiveness of the GPS on AR Drone 2.0.

Based on Figure-14, it can be concluded that in locations with wind speeds between 0 to 10 mph, the level of responsiveness of GPS extension in the AR Drone 2.0 is getting better. Even at a wind speed > 10 mph, the GPS failed to detect the location.

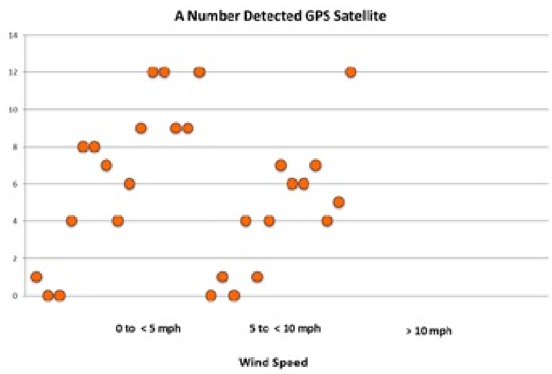

Figure-15. The effect of the wind speed on the number of the GPS satellites detected.

Based on the Fgure-15, it can be concluded that GPS satellites can detect only in environments with wind speeds from 0 to 10 mph.

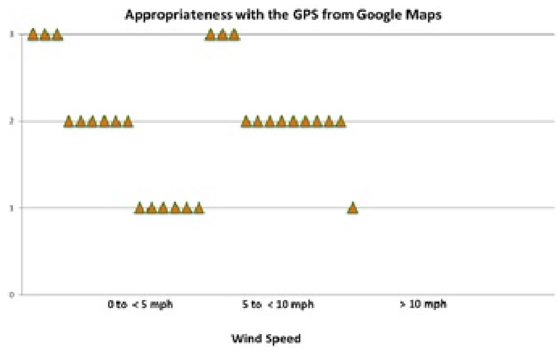

Figure-16. The effect of the wind Speed on appropriateness with the GPS from Google Maps.

Based on the picture 16, it can be concluded that at the locations with wind speeds between 0 to 10 mph, the GPS extension in the AR Drone 2.0 can capture a location with a diverse compatibility level when compared to Google Maps.

CONCLUSIONS

GPS extension on the AR Drone 2.0 is a major contribution in this research. But the new functionality in the AR Drone 2.0 is necessary to measure their performance through the level of responsiveness catching GPS location which is influenced by weather factors, temperature and wind speed.

Based on the test results in this research, it can be concluded that:

At the increasingly clear weather, the level of responsiveness of GPS extension module is getting higher. This level of responsiveness is influenced also by the ability of GPS to receive satellite signals on a clear weather. However, the wind speed is an important factor in the extension GPS functionality. At wind speeds over 10 mph, the extension GPS is malfunctioned,

The effect of temperature on this research greatly influenced by the temperature conditions in the range of testing the implementation of this research. However, the influence of temperature is directly proportional to the weather conditions, so the results of testing the effect of temperature can be represented by the test results on the influence of weather

REFERENCES

[1] Parrot AR.Drone 2.0 Review: Fly Higher, Farther, and More Intuitively. http://www.popsci.com.au/gadgets/parrot-ardrone-20-review-fly-higher-farther-and-more-intuitively, 377972.

[2] Pankaj Verma, J.S Bhatia. 2013. Design and Development of GPS-GSM Based Tracking System with Google Map Based Monitoring. International Journal of Computer Science, Engineering and Application (IJCSEA). 3(3).

[3] Ramani. R, Vanitha N. Suthanthira, Selvaraju. S, Thiruppathi. M, Thangam. 2013. Vehicle Tracking and Locking System Based on GSM and GPS. I.J.Intelligent Systems and Applications. 09, 86-93.

[4] SiRF, NMEA Reference Manual. California: SirF Technology.Inc, 2005

[5] Pujud, Aris. 2015. Mutiara Giva Andriana, Hapsari Gita Indah. Transmitting GPS as Text through Wireless on Drone 2.0.

[6] TECHNICAL SPECIFICATIONS STATE OF THE ART TECHNOLOGY.

[7] http://ardrone2.parrot.com/ardrone-2/specifications/.

[8] B. Massimo. 2009. Getting Started With Arduino. Make Books Publishing.

[9] ARDUINO. ARDUINO PRO MINI: Overview, Summary. http://arduino.cc/en/Main/ArduinoBoardProMini.

[10] B.W. Parkinson and S.W. Gilbert. 1983. Navstar: Global positioning system- ten years later.Proceedings of the IEEE. 71(10): 1177-1186.

[11] Patrick Lazik, Niranjini Rajagopal, Bruno Sinopoli, Anthony Rowe. 2015. Ultrasonic Time Synchronization and Ranging on Smartphones. 21st IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS 2015), Seattle, Washington.

[12] Putra lathief. R.D. 2015. Mutiara Giva Andriana, Hapsari Gita Indah. GPS Coordinate location based on AR Drone 2.0 Control and Image Data Capture. 2015.

[13] U-BLOX: NEO 6 U-blox 6 GPS Modules Datasheet. http://www.u-blox.de/images/downloads/Product_Docs/NEO-6_DataSheet_ (GPS.G6-HW-09005).pdf.

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