NTP SERVER DESIGN AS A TIME DIFFERENCE MITIGATION AT PERUM LPPNPI KENDARI BRANCH

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Abstract
In the world of aviation, it takes the right time, time synchronization is very important for the aviation system. If the time of the flight telecommunication facility is out of sync or out of sync, the flight data will be chaotic, so it is not known when the aircraft will land. If the time is not synchronized, data on accident incidents will be difficult to find. This research method uses an ESP32 Microcontroller connected to the NTP *Server* through internet media, then the NTP *Server* generates time data in the form of UTC (*Coordinate Universal Time*) time. The ESP32 microcontroller functions as a server on the device that will perform time synchronization, and the NTP Server data has accurate time accuracy. In the event of a time shift it will be compensated by the ESP32 Microcontroller.

Keywords: Network Time Protocol (NTP), *UTC*, ESP32, internet

1. INTRODUCTION

In today's era of globalization, air transportation technology is developing rapidly. In electronic transaction systems and telecommunications technology, it is very important for related parties to stay connected at the same time. All equipment must operate synchronously or in harmony within the system. Even if the system start time is set accurately, the time of each system will change after some time, if there is no attempt to synchronize the overall system time. Each system will calculate the clock time accurately, so the longer the difference accumulates, the greater the time difference. One example of the use of technology to obtain accurate time is *Network Time Protocol (NTP)* and *Global Positioning System (GPS)* [1].

Network Time Protocol (NTP) is a mechanism or protocol used to synchronize timekeepers in a computer system and network [2]. Considering that in the world of aviation, especially at AIRNAV, the Kendari Branch does not have an NTP Server, so for timekeeping, it still uses a digital clock that is not synchronized with the *UTC* so that the time designation is sometimes not synchronized with the time *UTC Realtime.* This is not in accordance with the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 65 of 2017 concerning Civil Aviation Safety Regulations Part 170 concerning Aviation Traffic Regulations [3]. This is often a finding from the Airport Authority Office due to improper or inconsistent time designation. If the aviation telecommunication facility has a time that is not synchronized, it will experience difficulties in a situation such as the time difference when the aircraft will land and take off between APP and ADC units. To overcome this problem, the author made a design of a tool that can synchronize the time in the APP and ADC rooms at AIRNAV Kendari Branch based on a microcontroller using ESP32, GPS NEO-M8M and LED P10 that takes time data *UTC* (*Coordinated Universal Time*) from the internet and local time from *Global Positioning System (GPS)* [4].

2. METHOD

The author uses the research method "*Research and Development*" (Research and Development). *Research and Development* is a research method used to produce a product and test the effectiveness of the product [5]. The research and development carried out in this study is based on the PPE model (*planning, production, and evaluation*) developed by Richey and Klein. Richey and Klein in Sugiyono (2016) stated "*The focus of research and development design can be on front end analysis planning, production and evaluation* (PPE)" including:

1. Planning

Planning (planning) means the activity of making a product plan. This activity began with aneeds analysis carried out through research [6].

2. Production

Production (Produce) is the activity of making products based on the design that has been made [7].

3. Evaluation

Evaluation (evaluation) is an activity to test and assess how high the product made has met the specified specifications [8].

Tool Design Diagram Block

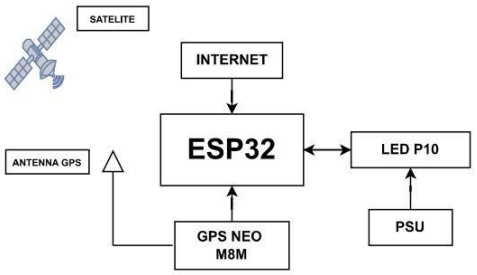

Figure 1. Block Diagram

In figure 1. Above is a block diagram of the NTP server design as a mitigation of time differences at PERUM LPPNPI KENDARI BRANCH.

How the tool works

The following is how the NTP server design based on the esp32 microcontroller works.

a. For time server *data retrieval* from the internet, the ESP32 must be connected to a wifi network connected to the internet. Once connected to the internet, the ESP32 will send a request containing information about the UTC time and be responded to by the NTP server with the right time.
b. For GPS, the Neo M8M will analyze the signal received from the GPS satellite to determine the exact location and use the time signal sent by the satellite to calculate the distance and determine the exact time. *Triangulation* is carried out using a minimum of 3 satellites to determine the exact location. Once the time signal from the satellite is received, the GPS module will process the data to determine the accurate time.
c. Once the accurate time data is determined, the time information from the internet and GPS of the Neo M8M will be entered as input to the ESP32. The data input will produce 2 outputs of information at the same time. The time information from the internet will act as the main and the time information from the GPS acts as a backup.
d. The output of the ESP32 will be displayed on the P10 LED display which will display the same time information i.e. UTC time information.

Tool Testing Techniques

This study uses functional testing techniques, to ensure that NTP *Server* and GPS can work correctly and provide accurate results. The stages in this test are:

1. Time Sync Testing

   This test is carried out to ensure that NTP *Server* and GPS can adjust the time well and synchronize with the standard time, which is UTC. This test is carried out by comparing the displayed time information with the time that is the source of reference, namely the atomic clock.
2. Time Accuracy Testing

   This test was carried out that theNTP *Server* and GPS can provide accurate results in showing time. This test is carried out by comparing the displayed time with the standard time, namely *UTC.*

Data Analysis Techniques

The data analysis technique used in this study is comparative analysis by comparing the value of parameters that have been made with other devices then the data that has been collected is described systematically. In this case compare:

1. The time speed range when the ESP32 sends a time format request over the internet and the time format from the GPS displays the time format on the LED screen without any interference and with any interference.
2. In the time range between the time given from the internet and GPS and the time present on the atomic clock will be recorded as the accuracy of the time comparison.

3. RESULTS AND DISCUSSION

1. Planning

In this part, tool design consists of tool design, how the tool works, and tool components used in the manufacture of equipment. The design of the tool in "NTP SERVER DESIGN AS MITIGATION OF TIME DIFFERENCE IN PERUM LPPNPI KENDARI BRANCH" can be seen in the diagram block image below.

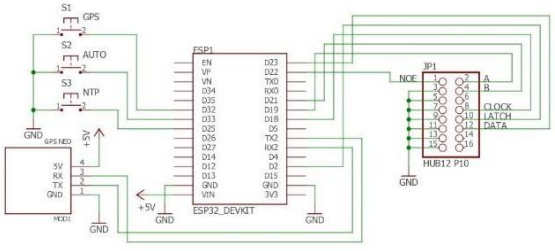

Figure 2. Tool Design Configuration

Number	Mode	Display Duration on P10 LEDs	Documentation
1.	Auto (start on)	9 seconds	
2.	Auto (NTP to GPS)	16 seconds	
3.	Manual NTP	0.16 seconds	
4.	Manual GPS	0.20 seconds	

Starting from the ESP32 which is connected to the P10 LED using a cable from the P10 LED, followed by GPS connected to the ESP32 with the configuration of the VCC pin on the GPS NEO M8M to the 5v pin on the ESP32 as a voltage source on the component, the GND pin on the GPS NEO M8M is connected to the GND pin on the ESP32. Connecting the GPS NEO M8M to the ESP32 with the TX pin configuration on the GPS NEO M8M to the RX2 pin of the ESP32 for sending GPS data to the satellite, then connecting the RX pin on the GPS NEO M8M to the TX2 pin on the ESP32 as receiving data from the satellite to the GPS and receiving it to the ESP32. Finally, connect the PSU to the P10 LED with the configuration of the L and N pins on the PSU to the AC voltage source, the V+ pin on the PSU is connected to the Positive LED and the V- pin PSU is connected to the Negative LED as the voltage source of all components used.

The way this tool works starts from turning on the P10 LED Screen by plugging the adapter into the voltage source. How the tool works can be seen in the Flowchart image below.

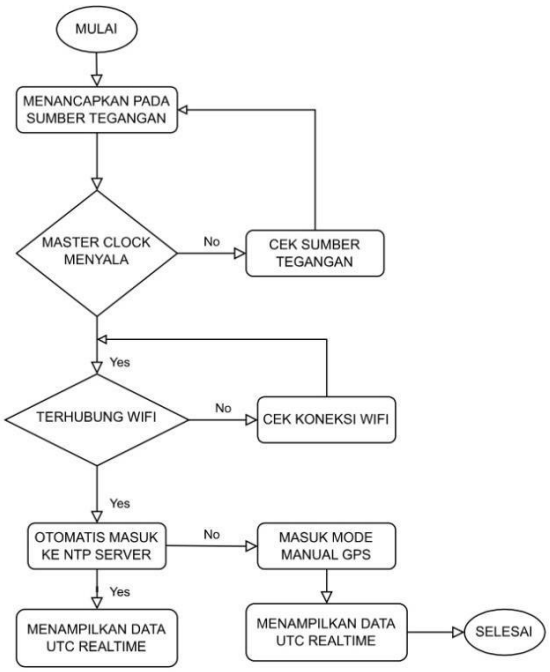

Figure 3. Flowchart How Tools Work

Starting from plugging the tool into the voltage source that is around, if the masterclock does not turn on, you can check the voltage source used, if it turns on, the masterclock will automatically connect to the wifi that has been set using the wifi around. The device is not connected to wifi can be checked on the wifi connection, if it is connected, it will automatically enter the NTP *Server* and will automatically display the time data i.e. the hour *UTC* in *realtime*, if the wifi is disconnected, it will automatically enter GPS mode and automatically display the time data *UTC* in *realtime*.

2. Production

After making a design plan for the manufacture of the tool, the design of the tool is carried out which has 2 stages, namely: software installation and hardware installation. The design of the tool is completed in accordance with the planning that has been determined, followed by the stage of testing the tool. The test was carried out with the aim of finding out the performance of the equipment and also the relationship between hardware and software.

Tool Testing

1. Duration of Appearance

In Manual NTP and Manual GPS modes when displaying on the LED screen, the P10 will measure how long the device can display time information. The following is a table of test results:

The test of the duration of the display whenturned on in each mode is different and is based on

accurate results by calculating the display time using the stopwatch on the laptop.

2. Accuracy Test

The results of the hardware and software design will be tested to prove whether the data captured from NTP and GPS is appropriate or *realtime* by comparing the data taken from the NTP server and the GPS Module compared with the NTP data in real-time on the following website *https://time.is/id/UTC* on a laptop. The results of the time accuracy test can be seen in the table below:

Number	Input	Accuracy Percentage	Documentation
1.	NTP	100%	
2.	GPS	100%	

The results of the design are evidenced by a comparison of time on the website *https://time.is/id/UTC.* In the above test, it was found that the time taken from the NTP *Server* and GPS is in line with the time *UTC realtime* with 100% accuracy or no delay.

3. Power Supply Unit Trial

The voltage input from the design results is tested to ensure that the incoming voltage is used as a voltage source from the P10 LED.

Number	Voltage Source	Result	Documentation
1.	Air conditioning	224.0 VAC	
2.	DC	5V	

The voltage source from the AC that enters the PSU and is channeled to the P10 LED is in accordance with the provisions, namely the input from the 220V PSU and the output from the PSU that is channeled to the P10 LED is 5V.

4. Internet Trial

Number	Wifi	Status	Documentation
1.	HOTSPOT POLTEK BANG	Does not light up	
2.	Mobile	Turn on	

If the wifi does not connect or the wifi speed is low, then the NTP Server cannot retrieve time data and cannot display *UTC* time in *realtime.* The wifi speed is fast, the time data can be retrieved from the NTP *Server* and displayed on the P10 LED for

approximately 9 seconds to be able to appear on the screen.

5. Antenna Test on GPS

Number	Location	Status	Documentation
1.	Indoor	Can't connect to GPS	
2.	Outdoor	Can connect with GPS	

When the GPS antenna is indoors, it cannot pick up signals from satellites so it cannot synchronize with *realtime UTC time.* In the image above, when the GPS mode is still running, but the clock will change at any time because it cannot synchronize with *realtime UTC time*.

3. Evaluation

After the previous stages, starting from Planning, tool design, production, tool assembly, and tool testing, the author evaluates the systems and equipment that have been designed according to existing needs, thus the evaluation is as follows:

1. Data input from the NTP server and GPS module can be received by the ESP32 and displayed on the P10 LED screen in the form of realtime UTC time information.
2. The source of information on the display time on the P10 LED screen adjusts to the wifi speed used.
3. This tool has 3 modes, namely: Auto Mode, NTP Manual Mode, and GPS Manual Mode. For Auto mode, you can display the time in *realtime*, but for wifi connections, if you use wifi from an IPHONE branded cellphone, it cannot automatically move to GPS, so for wifi networks you must use wifi from an ANDROID phone or a nearby wifi network.

4. CONCLUSION

In this final project, the author analyzes the performance of the NTP SERVER as a mitigation of time differences at the Kendari branch of Airnav.

Based on the results of testing and analysis, the following conclusions were obtained:

1. The NTP server design as a mitigation of time difference at AIRNAV Kendari Branch as a solution for accurate time information, this design uses ESP32 which is connected to WIFI, GPS module, and P10 LED. In this process, the ESP32 automatically connects to the wifi that has been *set* in the ARDUINO IDE cooding and automatically enters the NTP SERVER as the main display of the time information source. At the same time the GPS module receives information signals from satellites and then forwards to ESP32 to manage time information data, but this GPS module is only *standby*, if the NTP Server does not receive information data or is disconnected from *the server*, the GPS module can be a *backup* from the data of time information sources. The data information source from the NTP server and GPS will be displayed on the P10 LED screen. This design has succeeded in displaying UTC data in real-time from the NTP *server* and GPS data information sources which are the reference for world time.
2. This design was tested by comparing the time display results of the NTP server design with the UTC time display on the *website* displayed on the computer.
3. This design features 2 input time information sources, there are 3 display modes in this design, namely Auto Mode (NTP to GPS), NTP Manual Mode and GPS Manual Mode. These 3 modes can be displayed on the P10 LED screen and appear in *realtime*.
4. When using wifi on an android phone during auto mode, it can run smoothly, but ESP32 does not want to reconnect to wifi when disconnected. Meanwhile, if you use wifi on an iphone cellphone, auto mode does not want to run but wifi can *reconnect* .

Suggestion

Based on the discussion of the results of the research "NTP Server Design as a Mitigation of Time Difference at PERUM LPPNPI Kendari Branch", the suggestions related to the development of the research are as follows:

1. It is expected to be able to add an information data input source in the form of an RTC module so that it has many references to real-time information sources.
2. It is expected to be able to add a power source using solar panels aimed at saving electrical power.
3. It is expected to use wifi that is in accordance with the specifications.

4. It is hoped that raspberries or other components can be added so that the source data can be channeled to the *client.*

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