YAGI ANTENNA DESIGN TO REINFORCE THE 2,4 GHz WIFI SIGNAL RECEPTION USING ANDROID

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Abstract. The working principle of the 2,4 GHz Yagi antenna to strengthen the wifi signal by using android. The working principle viewed by the antenna rotation control by using android based mobile phone. Android phone will send a command to bluetooth in the circuit, then Bluetooth will send a command to arduino to rotate the servo 1 and servo 2. Both of them will rotate the antenna according to the desired angle. The angle will be displayed on the LCD. The antenns connected to the laptop that there is inSSIDer software that will display the amount of reinforcement (gain) obtained by yagi antenna that has been designed.

Keywords: Antenna and Propagation ; android ; gain ; frequency

I. INTRODUCTION

Rapid technological developments provide positive benefits to the lives of many people. These technological advances prove that distance, time and space is not a barrier for the human desire to interact constantly.

Different types of antennas are now being developed to keep abreast of current technology. Yani antennas that were once only used as a receiving antenna television broadcast and amateur radio receivers. Can now be used as a device that can amplify the reception signal with a frequency of 2,4 GHz wifi.

Wifi signal has been frequently used in various places, but sometimes the wifi signal is not strong so that the user was slow and also the antenna should be rotated manually to get a signal so people had to climb up the house when the antenna is above the house to get a good antenna position

II. LITERATURE REVIEW

A. *Antenna*
A.1 Sense Antenna

According D.Yurry (1995:78), the antenna is one thing that can resonate, on a regular resonating circuit antenna the size of a supporting component for an antenna is necessary because without the support of an electronic circuit is cleary not going to give optimal results in the consumer. Antenna is an important instrument in a radio communication system. Antenna is also defined as a tool for sending and receiving electromagnetic waves, depending on the usage and frequency of use ,the antenna can be formed from a variety of forms, ranging from a wire, dipole, or yagi. Types of antennas to be installed should be in accordance with the system that we are building,well adapted to the needs of the spread signal.

A.2 *Yagi Antenna*

According Francis D Yuri (1996:28), Yagi is the name of an inventor parasitic antenna elements are the most popular used by people,although a larger structure, but easily made,as well as adequate adjustment to the feeder once. Yagi models can be created with the arrangement of three elements and elements are 12 elements most when desirable gain for the dipole at 14 dB,15 dB etc. The arrangement of elements can be stacked in away that one above the other and can also with the structure of sideways according to taste.
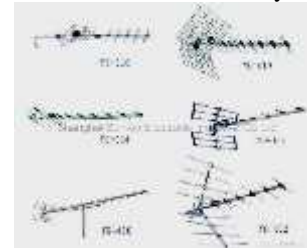
Gambar 1. Model Yagi Antenna

Element Yagi-Uda antenna consists of :
1. Driven

   Driven supply point of the antenna cable, usually driven physical length is half the wavelength (0,5) of the radio frequency emitted or received.
2. Reflector

   Reflector is rear reflector antenna that serves as a signal to the physical length is longer than the driven,usually the length is 0,55 (wavelength).
3. Director

   Director is part of directional antennas director,size is slightly shorter than driven. Extra rods director will add antenna gain,but will make the antenna alignment pattern

becomes narrower the more. The number of directors,the more narrow direction.

4. Boom

Boom is placed driven parts, reflectors, and director. Boom shaped piece of metal of wood in length along the antenna. Yagi antenna also has a space (gap) between the elements. The distance is generally the same ,is 0,1 of frequence.

B. *Operating Sistem Android*

Android is a linux-based operating system that is used as the management of hardware resources both for mobile phones,smartphones and tablet PCs. In general android is an open platform for developers to create their own applications for use by a variety of mobile devices. In other words the android is a linux based open source that can be used to create applications in accordance with the wishes.

C. *Amarino Software Toolkit*

According to Eco Jazi (2014:214) Amarino toolkit created by Bonifaz Kaufmann, which was created as an intermediary tool serial communication between third-party applications to bluetooth devices on android to submit to the board arduino BT or Bluetooth Shield. This Toolkit will simplify the use of serial communications without pairing process. Delivery ASCII data from android application to the target board is done by defining the MAC address of the destination device. Amarino also able to send data simultaneously to multiple devices receiver module.

D. *Liquid Crystal Display (LCD)*

Elektronic Display is one of the electronic components that serves as a display of data, character, letters of graphs. LCD is one type of electronic display made with CMOS logic technology that works with do not produce light but reflect the light surrounding her to frontlit of transmits light from the back-lit.

E. *Servo motors*

Servo motor is a DC motor with a closed feedback system in which the position of the rotor will be communicated back to the control circuit in the servo motor. This motor consists of a DC motor, a set of gear, potentiometer, and the control circuit. Potentiometer serves to define the limits of the angle of rotation servo. While the angle of the axis servo motors regulated by pulse width signal sent through the legs of servo motor cables.

Figure 2. Servo Motors

III. METHODOLOGY

A. Yagi Antenna Design

Yagi antenna design was designed at a frequency of 2,4 GHz, the author designed the antenna based on the literature of guidebooks and the internet to make the antenna according to the length of the elements that has been set. Size and diameter of these elements affect the performance of the antenna. Elements are made on Yagi Antenna are 17 elements.

B. Driver Design

The material used for driven is copper wire. Before determining how long driven, calculate how long wavelength( ) and calculate driven to be made with the formula :

$$\lambda = \frac{c}{f}$$
$$= \frac{300 \cdot 10^6}{2400 \cdot 10^6}$$
$$= 0,125 \, m$$
$$= 12,5 \, cm$$

The next search long driven elements

$$Driven = 0,5 \, \lambda$$
$$= 0,5 \times 12,5 \, cm$$
$$= 6,25 \, cm$$

C. Reflector of Design

The materials used for the reflector is a copper wire. formula in determining the length of the reflector:

REFLECTOR = 0,55
= 0,55 x 12,5 cm
= 6,25 cm

reflector is rear reflector antenna that serves as a signal, the physical length is longer than the driven ie 0.55 , because the calculation result obtained is not an integer so when cutting reflector, reflector size rounded up to 6.9 cm in diameter 0.15 cm.

D. Director Design

The material used for the director is a copper wire. director of elements made as many as 15 elements. before determining how long directors, calculate the length of directors that will be made with the formula:

Direktor1 = Driven – 0,01
= 6,25 – 0,125
= 6,135 cm
= 6,12 cm

Table 1. Data on calculations for elements yagi antenna

Jenis Elemen	Panjang direktor (cm)
Reflektor	6,9
Driven	6,25
Direktor 1	6,12

Direktor 2	5,93
Direktor 3	5,7
Direktor 4	5,41
Direktor 5	5,03
Direktor 6	4,59
Direktor 7	4,1
Direktor 8	4,1
Direktor 9	4,1
Direktor 10	4,1
Direktor 11	4,1
Direktor 12	4,1
Direktor 13	4,1
Direktor 14	4,1
Direktor 15	4,1

the distance of each element in yagi antenna with λ = 12,5 cm

reflector distance to driven = 0.35

$$= 0,35 \times 12,5 \text{ cm}$$
$$= 4,375 \text{ cm}$$

rounded up to 4.4 cm

driven distance to director 1 = 0.14

$$= 0,14 \times 12,5 \text{ cm}$$
$$= 1,75 \text{ cm}$$

director 1 distance to director 2= 0.18

$$=0,18 \times 12,5 \text{ cm}$$
$$= 2,25 \text{ cm}$$

director 2 distance to director 3= 0.25

$$=0,25 \times 12,5 \text{ cm}$$
$$= 3,125 \text{ cm}$$

rounded up to 3.13 cm

director 3 distance to director 4= 0.27

$$=0,27 \times 12,5 \text{ cm}$$
$$= 3,375 \text{ cm}$$

rounded up to 3.4 cm

director 4 distance to director 5= 0.30

$$=0,30 \times 12,5 \text{ cm}$$
$$= 3,75 \text{ cm}$$

rounded up to 3.8 cm

director 5 distance to director 6= 0.35

$$=0,35 \times 12,5 \text{ cm}$$
$$= 4,375 \text{ cm}$$

rounded up to 4.4 cm

director 6 distance to director 7= 0.36

$$=0,36 \times 12,5 \text{ cm}$$
$$= 4,5 \text{ cm}$$

For the others direction using distance 0,35 – 0,42 (Anonim,1974 :153)

Table 2. Data of calculations for distance between elements Yagi Antenna

Jenis Elemen	Jarak antar elemen (cm)
Reflektor ke Driven	4,4
Driven ke Direktor 1	1,75
Direktor 1 ke Direktor 2	2,25
Direktor 2 ke Direktor 3	3,13
Direktor 3 ke Direktor 4	3,4
Direktor 4 ke Direktor 5	3,8
Direktor 5 ke Direktor 6	4,4
Direktor 6 ke Direktor 7	4,5
Direktor 7 ke Direktor 8	4,5
Direktor 8 ke Direktor 9	4,5
Direktor 9 ke Direktor 10	4,5
Direktor 10 ke Direktor 11	4,5
Direktor 11 ke Direktor 12	4,5
Direktor 12 ke Direktor 13	4,5
Direktor 13 ke Direktor 14	4,5
Direktor 14 ke Direktor 15	4,5

E. How The Tool Works

How to tools work from Yagi Antenna 2,4 GHz for increase acaptable wifi signal use android is handphone based on android, will active Bluetooth HC-05 in circuit with Bluetooth in handphone, use amarino then Bluetooth will send order to arduino module, arduino modul will get supply voltage from power supply and then servo 1 and servo 2 will rotate as by turned and will make rotating as 360° that will rotate antenna that already connected to servo. Then the direction will appear an lcd . Antena connected to laptop for see how much gain that is gotten from antenna using inssder software. Antena yagi inthis tool have function for increase wifi signal that is accepted from workstation. Principle working of yagi antenna same like yagi antenna in common. That is every signal that is accepted from yagi antenna wiil be connected through elements in that every signal that is accepted from Yagi Antenna wiil be connected through elements in that antenna and the other signal gather in one line, where that line will be reflected by reflector.

IV. RESULTS

Calculation antenna gain can be counting with formula under below :

$$GA = P_{RA} - P_{Rr}$$

Explaination :

GA : Antena Gain
P_{RA} : Power that is resulted from yagi antenna.
P_{Rr} : Power that isn't resulted from yagi antenna with using formula on that calculation antenna gain from that table 4.3 as below :

1. In distance 3m

GA = P_{RA} - P_{Rr}
= -50dB – (-54 dBm)
= 4 dB

2. . In distance 5 m

GA = P_{RA} - P_{Rr}
= -50dB – (-53 dBm)
= 3 dB

3. . In distance 9m

GA = P_{RA} - P_{Rr}
= -56dB – (-61 dBm)
= 5 dB

4. . In distance 13m

GA = P_{RA} - P_{Rr}
= -57dB – (-70 dBm)
= 13 dB

5. . In distance 15m

GA = P_{RA} - P_{Rr}
= -55dB – (-63 dBm)
= 8dB

After do testing toward tool that yagi antenna 2,4 GHz for increase acaptable signal wifi using insider software, testing is done in 6 distance that is different. Testing is done in beside laboratory telecommunication engeneering in 2 floors. We can see that gain that enough big until 13 dB. Thi is caused testing by done out of the room. So antenna position is high and no obstacle with anything, antenna element can influence power cathched by antenna because as much as element so antenna can also catch much signal is using by antenna in all around.

B. Testing in the room (Telecomucation engeneering Class)

Antenna gain using USB wireless adapter and yagi antenna :

In distance 2m

. GA = P_{RA} - P_{Rr}
= -50dB – (-59 dBm)
= 9 dB

In distance 5m

. GA = P_{RA} - P_{Rr}
= -59dB – (-65 dBm)
= 6 dB

After do this testing forward to this tools, such as yagi antenna 2,4 GHz for increase acaptable signal wifi, this testing is done by 2 distance that is different caused by testing by class room so can not possible for test farthest distance so the writer only test in nearest distance, such as 2m ang the farthest distance is 5m. So we can see gain with 2m distance is 9 dB and the farthest distance is 5m, he antenna is still created as much 6 dB.

V. CLOSING

5.1 Conclusion

From the result of testing that is done, so can be taken. Conclusion is :

1. Yagi antenna that is built for give gain until 13 dB when outside testing and the gain is until 9 dB when testing in inside.
2. Gain when testing out side room more bigger compare testing inside room, testing in every direction with antenna rotating controller using handphone based on android, eventhought USB wireless adapter and yagi antenna
3. The gain in yagi antenna can be inluanced because of some factors, the factors is :
   1. How much is elements
   2. Testing distance, and
   3. How much direction that is control using handphone based on android.

5.2. Suggestion

Advice to authors give in this paper that when a measure strengtheniny   at every angle, slide the control applications yagi antenna on android phone slowly and make sure the angle shown on the LCD Is not much different from the angle determined because it can affect the msgnitude of the gai n generated by the antenna.

REFERENCES

[1]   D. Yury, Francis. 1993. *Antene TV Swasta*. Demak : CV. Media Ilmu
[2]   Joko, Tri. 2008. *Antena Wireless untuk Rakyat, Panduan Membuat Sendiri Beragam Antena Wireless 2,4 GHz.* Yogyakarta : CV. ANDI
[3]   Kaufmann, Bonifaz dan Jazi Eko. 2010. *Design and Implementation of a Toolkit for the Rapid Prototyping of Mobile Ubiquitous Computing*. http://www.amarinotoolkit .net/tl_files/thesis/amarino_thesis_kaufmann _2010.pdf (Diakses pada 3 Mei 2016)
[4]   Lestari, Yurika Arta. 2015. *Rancang Bangun Antena Yagi 2,4 GHz untuk Memperkuat Penerimaan Sinyal 3G.* Digilib.polsri.ac.id (Diakses pada tanggal 15 Maret 2016)
[5]   Sari, Widya Mayang. 2015. *Rancang Bangun Antena Eksternal Parabolik 2,4 GHz untuk Komunikasi Wireless LAN (WLAN)"*. Digilib.polsri.ac.id (Diakses pada tanggal 15 Maret 2016)
[6]   Suryani, Ika. 2015. *Rancang Bangun Sistem Kendali Kipas Dan Lampu Bertenaga Surya Berbasis Android.* Digilib.polsri.ac.id. (Diakses pada tanggal 12 April 2016)