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Manufacture of Offset Parabolic Antenna Drive Device for *Automatic Satellite Tracking*

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A B S T R A K

Perkembangan Teknologi Informasi dan Komunikasi (TIK) belakangan ini telah mengalami kemajuan pesat, termasuk dalam dunia hiburan. Penggunaan TIK untuk penyiaran program televisi melalui internet dan parabola memungkinkan akses informasi global tanpa batas ruang dan waktu. Indonesia, sebagai negara dengan jumlah penduduk besar dan geografis yang luas, mengandalkan teknologi parabola untuk menerima siaran televisi satelit. Namun, keterbatasan jumlah siaran dari satu satelit memerlukan solusi efisien untuk menambah saluran tanpa menambah disk parabola. Alat penggerak antena parabola yang dikendalikan melalui sistem kontrol menjadi solusi yang memungkinkan pencarian satelit secara manual maupun otomatis. Penelitian ini merancang dan menganalisis alat penggerak antena parabola dengan spesifikasi teknis dan proses manufaktur yang detail, termasuk pemilihan bahan, perakitan, dan pengujian performa. Hasilnya menunjukkan alat yang dapat diandalkan dengan ketelitian tinggi dan kemudahan penggunaan, memenuhi kebutuhan pengguna dalam menangkap siaran televisi satelit dengan efisien. Dengan demikian, inovasi ini tidak hanya meningkatkan kualitas hiburan, tetapi juga memberikan dampak positif dalam hal akses informasi bagi masyarakat luas.

Kata kunci: Teknologi, Komunikasi, Parabola, Satelit, Penggerak

A B S T R A C T

The development of Information and Communication Technology (ICT) has recently experienced rapid progress, including in the entertainment world. The use of ICT for broadcasting television programs over the internet and satellite dish allows global access to information without the limits of space and time. Indonesia, as a country with a large population and a large geography, relies on satellite dish technology to receive satellite television broadcasts. However, the limitation of the number of broadcasts from a single satellite requires an efficient solution to add channels without adding a parabolic disk. Parabolic antenna propulsion devices controlled through a control system are a solution that allows manual or automatic satellite search. This research designs and analyzes parabolic antenna propulsion devices with detailed technical specifications and manufacturing processes, including material selection, assembly, and performance testing. The results show a reliable tool with high precision and ease of use, meeting the needs of users in capturing satellite television broadcasts efficiently.

Keywords: *Technology,Communication,Parabola,Satellit,Drive*

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INTRODUCTION

The use of information and communication technology (ICT) has had a significant impact on global economic growth. (Lee and Lee, 2019) found that ICT has an important role in increasing business competitiveness and capabilities, as well as promoting economic growth in various countries. The results of this study are supported by other studies that show that ICTs plays an important role in promoting economic growth in both developed and developing countries (Nguyen, Nguyen, & Phan, 2020). In addition, (Ozdemir and Uyar, 2019) found that ICTs have a positive impact on economic growth, based on a comparative analysis between developed and developing countries.

The use of satellite technology in satellite television broadcasting systems has become important in Indonesia, the country with the 5th largest population in the world. (Wibowo, 2012) elaborated on the importance of satellite technology and its use in satellite television broadcasting systems as well as how to use mini satellite dish devices for satellite television reception, especially in remote areas. (Mubarok and Irawan,2017) also described the use of mini satellite dish devices for satellite television reception, particularly in remote areas.

One solution for adding satellite television broadcasts without the need to add a disc is to move the disc position to the desired satellite. However, manual disc redirection is inefficient and inaccurate. Therefore, a drive mechanism that is easy to use and has a high level of precision is required so that the parabolic disc can be moved optimally.

In this study, the authors created a parabolic antenna propulsion device that can be controlled via a control system, allowing satellite searches both manually and automatically. Satellite television refers to a television broadcasting system that uses satellite communication devices as its transmission channel and is received by receiving devices, such as satellite dishes and set-top boxes.

The development of satellite technology has positively contributed to entertainment and access to information, as well as being an impetus for local innovation in the development of satellite broadcast receiving equipment to make it more efficient and easier to use by the wider community. Using satellite technology, people can access a wide range of television programming channels globally, allowing them to broaden their horizons and knowledge.

Satellite technology has also improved business capabilities and quality of life. By using satellite technology, businesses can easily access global markets and improve product production and distribution capabilities. In addition, satellite technology has helped improve people's quality of life by providing access to a wider range of information and entertainment.

In conclusion, the use of satellites and ICT technology has made a positive contribution to economic growth and business capabilities, as well as improving people's quality of life. Therefore, it is necessary to continue to increase the use of satellite and ICT technology to improve business capabilities and people's quality of life.

RESEARCH METHODS

The design stage of a product begins with a literature study and data collection to understand the context and needs, followed by the development of basic product concepts and creation of technical drawings that include detailed specifications. Subsequently, material orders are placed according to predetermined specifications, and then raw materials are processed into components according to the design in the manufacturing stage, followed by the component assembly stage into a single unit. The final stage is the trial of the machine to ensure the performance, safety, and reliability of the product in accordance with the previously established standards.

These stages form sequential steps that help ensure that the resulting product meets specifications, quality standards, and user needs. This process describes the entire journey from conception to ready-to-use finished products.

A. Research Completion Diagram

Every work that will be conducted has certain stages as a reference. The stages were made in the form of a flow chart or a flowchart of the process of activities carried out during the final project. The flowchart is as follows.

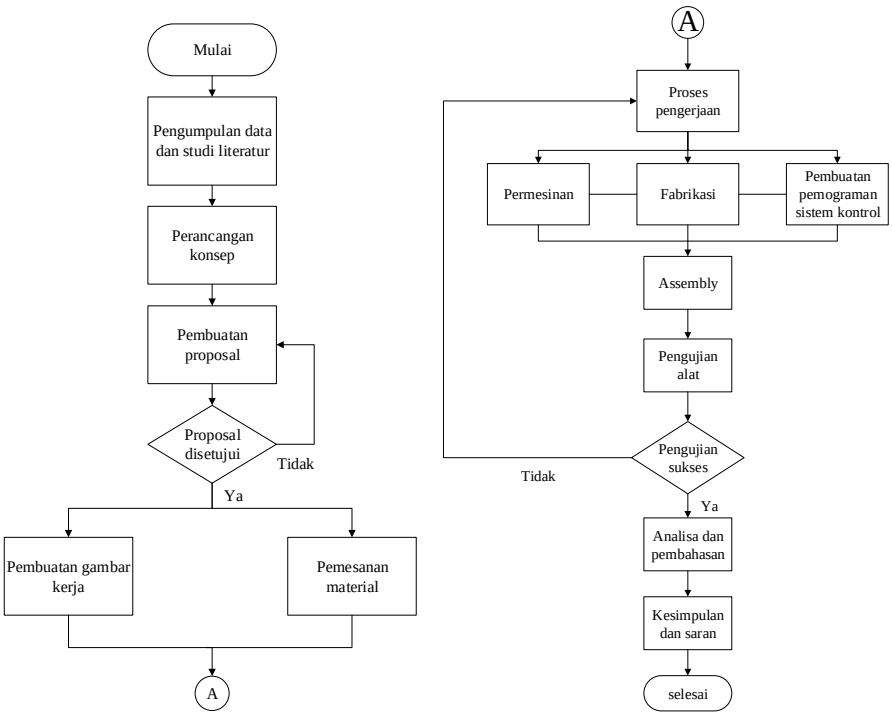


Figure 1. Flowchart of the research stages.

B. Data Collection and Literature Study

In the Data Collection and Literature Study stages, Data Collection Techniques are first carried out using observation methods, where direct observation is carried out on processes or objects that will be designed to understand existing phenomena (Wibowo, 2012). This observation aims to understand the situation based on previous knowledge, especially the tools to be developed. Furthermore, a Literature Study was conducted by collecting references from books and literature relevant to machine design (Mubarok & Irawan, 2017). This method ensures that the obtained information is updated and reliable. In addition, this stage involves discussions with supervisors and peers to obtain input and a broader understanding of the design to be carried out. Concept Design

The concept design begins by establishing the working mechanism and supporting equipment to be used. After determining the supporting equipment, the next step was to create a series of sketch drawings.

C. Drawing Creation

The design stage begins with designing or drawing the arrangement of the machines and parts of the parabolic antenna propulsion device. Images were created using Autodesk Inventor Software application. Some aspects that must be considered in the design include the selection of alternative

machines to be made, material selection, machining processes, and estimated processing time. At this stage, all parts of the machine are designed either personally or tailored to the purchased components.

A. Manufacturing Stage

Working drawings make it easier for workers in the component manufacturing process (Sugiyono, 2018). The manufacture of satellite dish antenna drive tools involves several components that require a machining process, such as transmission shafts, flange bushings, and lathe-bushings, as well as shafts and bushings that are fed with peg grooves using a milling machine, while flange bushings undergo the broaching process. These parts were then cut using a chainsaw. Plates that were cut and marked were perforated with a table drilling machine with a diameter of less than 12 mm and a radial drilling machine with a diameter of more than 12 mm (Mubarok & Irawan, 2017). The correct selection of the machine affects the quality and manufacturing time of the components, according to their profile and level of precision. All plate-shaped components were fabricated by cutting using oxy-acetylene welding. The control system of this tool is controlled using a PC.

B. Tahap Perakitan (Assembling)

The assembly stage was performed after all parts of the manufacturing process were completed. This stage aims to combine each component. The equipment used in the assembly process included electric welds, Allen locks, screwdrivers, and files. This process includes mechanical assembly and control system assembly.

C. Tahap Uji Coba Mesin

This stage involves testing the movement of the chain and sprocket as a driving tool and control system that has been created, and examining whether all components work according to their respective functions. The engine trial stage involves testing the movement of the chain and sprocket as the driving mechanism and control system that has been created. The purpose of this trial was to ensure that all the components functioned properly and were in accordance with their respective tasks.

D. Tuntutan Konstruksi

The list of specifications of a design aims to identify and define the requested requirements. This section provides the technical details of the design so that the boundaries of the design will be clearer in meeting the requested needs if the data are carefully and accurately arranged. The following is a list of specifications of the Parabolic Antenna Driving Tool for Satellite TV Offset Tracking.

- Design: This design emphasizes the use of materials that are easy to find, with simple engine designs and easy availability of replacement parts.
- Manufacturing Process: Designed components should be easy to assemble and manufacture, ensuring the availability of manufacturing equipment and the ease of replacement of parts.
- Assembly: The installation of components should be carried out easily, considering the availability of equipment at each stage of assembly.
- Operation: The use of the tool should be simple, with the minimum number of operators required and an uncomplicated setup process.
- Care and Maintenance: Component replacement should be easy, without the need for specialized technician expertise and without the use of special equipment.

- Materials or Materials: Prioritize the use of materials or materials that are commonly available in the market by ensuring that the materials used meet safety and construction strength standards and have adequate strength.
- Cost and Time: The cost of manufacturing should be affordable, with efficient design time and accessible maintenance costs.

RESULTS AND DISCUSSION

A. Design Pictures

The design of the tool consisted of a plate material, pipes, sprocket chains, mini satellite dishes, and reducer gearboxes with a ratio of 1:40. The shape of the design resembles that shown below.

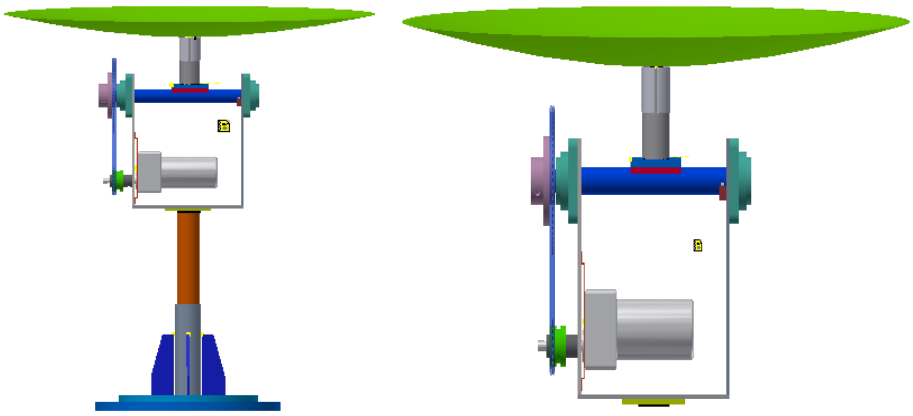


Figure 2. Image of Parabolic Antenna Drive Device

B. Capability Analysis of Motors, Maximum Load

In this study, the ability of the motor to withstand the maximum load was analyzed. Based on the data, the torsion moment on the shaft, required force, and torsion moment acceptable by the shaft can be determined. From the data provided, the specifications of the motor were identified as follows: rotation speed (n) of 22 rpm, radius (r) of 35 mm, radius of shaft (R) of 82 mm, voltage (V) of 24 V, and current (I) of 5 A. First, the power of the motor was calculated using the formula $P = V \times I$, which resulted in a value of 120 Watts.

The twisting moment (Mp) was calculated using the formula $Mp = (9550 \times P)/n$. The calculation results show that the torsional moment of the shaft was 52,090.9 Nmm. The force acting on the chain was also calculated using the formula $Mp = F \times r$, and the value of the force obtained was 1488.31 N. Then, the torsional moment that can be accepted by the shaft is calculated using the formula Mp Axis = $F \times R$, and the result is 122,041.5 Nmm. This value was used to test the ability of the shaft to move a disc at a certain angle.

The results of the calculations are presented in Table 1, which shows the load testing on the discs with specific angle variations. From these results, it can be observed that the twisting moment of the shaft can withstand loads at different angles. Thus, a deeper understanding of the capabilities of the motor with maximum load is obtained through the analysis that has been carried out. In addition, the relationship between the moment of twisting of the shaft and the force acting on the chain, as well as the ability of the shaft to withstand the load at a certain angle, can be observed from the results of the calculations that have been made.

Table 1 Load Testing on *Disc*

No	F	L	Sudut (α)	Mp
1	38 N	200 mm	10 ˚	7.484,53 Nmm
2	38 N	200 mm	20 °	7.141,50 Nmm
3	38 N	200 mm	30 °	6.581,79 Nmm
4	38 N	200 mm	40 °	5.209.10 Nmm
5	38 N	200 mm	50 °	4.885,18 Nmm
6	38 N	200 mm	60 °	3.800 Nmm
7	38 N	200 mm	70 °	2.599,35 Nmm
8	38 N	200 mm	80 °	1.319,72 Nmm
9	38 N	200 mm	90 °	0

C. Motor mount or antenna mount

The manufacturing of a motor mount or antenna mount involves several steps. First, a material plate with a thickness of 1/4" was cut using a sharing machine into two pieces measuring 283 × 154 mm (as a support) and one measuring 240 × 154 mm (as a support stand). After cutting, the plate was ground to remove the slag. The plate was marked according to the prepared working drawings. Next, the plate undergoes a machining process in which flange-bearing bolt holes with a diameter of Ø12 are made on both support plates. On one of the supports, a hole with a diameter of Ø38 was drilled for the movement of the motor shaft, and a hole in the bolt of the motor tie with a diameter of Ø6. The support mount plate was perforated to a diameter of Ø12.

The rotational speed (rpm) of the drilling machine was calculated for each hole size. For a hole with a diameter of Ø3, the Rpm of the drilling machine was calculated using the formula (Vc × 1000)/πxd, and the result was 2440.37 Rpm. For a hole with a diameter of Ø6, the Rpm of the drilling machine was 1220.18 Rpm. For a hole with a diameter of Ø12, the Rpm of the drilling machine was 610.09 Rpm. For a hole with a diameter of Ø38, the Rpm of the drilling machine was 192.66 Rpm. This calculation is important to ensure the correct speed in the drilling process so that the results are in accordance with the desired results.

D. Drive Shaft

The manufacture of the drive shaft to drive the antenna disc involves several stages. The drive shaft is made of round bar material with a diameter of 1 1/2". This round bar was cut into two parts using a saw machine, with a material length of 410 mm for the main shaft and 60 mm for the small sprocket bushing. The cut material was then lathe until it reached a diameter of Ø30 mm. A lathe process was performed at both ends of the shaft until it reached a diameter of Ø25.4 mm. The rotational speed (RPM) of the lathe was calculated for each diameter to be turned. For a diameter of Ø1 1/2", the RPM of the lathe was calculated using the formula (Vc × 1000)/πxd and resulted in a value of 192.15 RPM. For a diameter of Ø30 mm, the RPM of the lathe was 244.07 RPM. As for the diameter of Ø25.4 mm, the RPM of the lathe is 288.23 RPM. In addition, RPM calculations are also carried out for the chamfer process. Chamfer is the process of smoothing or angling the end of the shaft. The lathe RPM for the chamfer is calculated using the formula (1/3) x (Vc x 1000)/πxd and results in a value of 81.34 RPM. This calculation is important to ensure the right speed in the turning process so that the results are in accordance with the desired specifications.

CONCLUSION

The process of manufacturing movable offset parabolic antenna drive devices with control systems involves several stages and careful analysis. The design of this tool consists of plate materials, pipes, sprocket chains, mini satellite dishes, and reducer gearboxes with a ratio of 1:40. The analysis showed that the motor had a rotation speed specification of 22 RPM, with a power of 120 Watts, and a torsional moment of 52,090.9 Nmm and a force on the chain of 1488.31 N, proving that the shaft is capable of withstanding a load with a torsional moment of up to 122,041.5 Nmm. Load testing on discs with angular variations confirms the ability of the shaft to withstand loads at different angles. Stand manufacturing involves cutting and machining plate material with the calculation of the correct rotary speed of the drill machine for each hole size, ensuring structural stability and strength. The manufacture of drive shafts involves the cutting of round bars and the turning process with the calculation of the rotational speed of the lathe to ensure accurate results, as well as the chamfer process to smooth the shaft ends. This entire process results in an offset parabolic antenna drive tool that works as expected, with each stage performed with careful calculation and attention to detail, ensuring a final result that meets specifications and functions properly.

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