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Research Paper

The Prototype Electric Steering Gear Based Microcontroller Arduino

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Abstract

Globalization has led to the advancement of science and technology in all aspects of human life. The rapid development of science and technology significantly influences both learning methods and employment. As a result, many effective learning methods are being utilized, and one of them is the control system in electric steering gear, which enables the remote control of auxiliary machinery. Therefore, the creation of a demonstration tool for auxiliary machinery on ships is highly suitable for the era of globalization. The type of demonstrative tool created by the author is an updated version of the electric steering gear with remote control capabilities. The Research and Development method is employed in this study, which involves a process or steps to develop a new product or improve existing ones, including both hardware and software components. The model used in this development research is the procedural model, outlining the sequential and gradual steps from the initial process to the final one. The construction of the demonstrative tool for the updated electric steering gear involves three electronic modules: the ESP 8266 module, the Servo Motor, and the Wi-Fi module. The ESP functions as the microcontroller, the Servo Motor is responsible for the steering direction and angle position control, while Wi-Fi serves as the control medium. The author has made improvements to the electric steering gear demonstrative tool, which typically uses a lever, by implementing smartphone control as a substitute. The working system of this demonstrative tool is to set the degree of the steering angle position and respond to control signals by moving the shaft to the desired position. This system functions with the support of the automation control system provided by the electronic modules.

Keywords: *Props; Electric steering gear; electronics module*

INTRODUCTION

Sea ship transportation is one form of transportation carried out through waters, such as seas, rivers, and lakes. Ships are the most common means of transportation used in sea transportation, with various sizes and types used to transport passengers, goods, fuel, and various other types of cargo. Ship sea transport has several advantages compared to land or air transport. The ship is able to carry a large amount of goods and cargo in one trip, making it more efficient in terms of cost and time. Ships also have greater flexibility in transporting large and heavy cargo. Reliable ships provide a comfortable operation safely when the ship sails. In terms of ship maneuvers, of course, in terms of ship motion, it requires a steering system, namely steering *gear*. The ship's steering system is the system responsible for controlling the direction and movement of the ship on the water. The system consists of several components, including steering, steering wheel, steering drive mechanism, control system, and steering assist system. The main components of the ship's steering system can be driven by the ship's engine power. Most modern ships use hydraulic steering control systems *with the addition of an electronic steering control system as backup or to improve the accuracy and responsiveness of* hydraulic systems. The combination of these two systems ensures more stable and secure control and minimizes the risk of system failure under extreme conditions. As innovation has grown, there has been the development of frameworks known as control frameworks. This control framework is an approach that allows both in-person and remote settings and can even combine both techniques. In this study, the attention of creators of the study focused on the model that used prototype steering *gear* based on an

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Arduino microcontroller. to find out the angle of degree or control of the steering leaf to the right or left before. Control can usually only be done manually directly on the platform. However, with the remote control system, control or operation of angles and maneuverable steering leaves can be done via smartphone by utilizing a *Wi-Fi* network. Based on the background above, the following problems can be formulated:

1. How to make an electric prototype steering gear based on an Arduino microcontroller?
2. How does the electric steering gear prototype based on an arduino microcontroller work?

LITERATURE REVIEW

Design includes associating and organizing the expected data from the newly created system. This design stage is important because it provides an overall picture of the overall plan as a guide for developers to create applications. This stage involves setting up equipment or programming, databases, and applications that correspond to the required area of the system. By doing good planning, developers will have clear guidelines for developing effective and efficient systems, and teaching aids are learning media in the form of physical objects that act as equipment and learning innovation programs. Teaching aids have a major role in improving and explaining learning materials, especially in the form of hardware that is ready to use.

Electric Steering Gear or Electric Steering System is one type of steering system on ships that uses electric power as a power source to drive the steering wheel. This system utilizes an electric motor connected to the steering wheel through a gearbox to control the vessel's direction. This electric steering system has several advantages compared to conventional hydraulic steering systems. Some of them are more efficient in energy use, easier in maintenance and repair, and more accurate and responsive in controlling the ship's direction. Control systems are various ways or systems arising from human tendencies in the work environment, where individuals need feedback on their actions so that the quality formation process runs well.

The development of mechanical technology has encouraged people to continue looking for ways to automate work previously done by humans (Triwiyatno, 2011). Hypothetically, there are many factors that cause difficulties for cadets in using previous learning methods. To overcome this problem, researchers provide evidence that distinguishes the problem and presents a plan of action to be taken, especially on the part of remote control and programming systems, which do not get adequate attention in the campus environment. By adopting the use of databases as a driver of microcontroller-based remote control systems and Wi-Fi modules or internet networks, it will be able to increase understanding of programming over the internet.

RESEARCH METHOD

The research method used in this study is the Research and development (RnD) method.

1. Research method phase I (Research)
   a. Qualitative methods
      In this study, the author will use qualitative methods to adjust the problems studied and problems that occur in the field.
   b. Research Sites
      This research was conducted in a private workspace owned by the researcher.
   c. Sources of research data
      The subject of the research that the author will take comes from auxiliary machinery on board. Design refers to the process of translating the results of analysis into prototypes or design models that aim to create or improve existing systems.
   d. Data collection techniques

The steps to obtain data and information as material and design the development of these tools can be obtained through observation, literature, and documentation.

e. Data Analysis
In this research, data analysis is needed because it requires tools and materials that will be used to make this prop, especially in the microcontroller programming section.

f. Product design design
In this study, researchers made a design or props in a small-sized device from the object developed. The steps taken are the first stage of analysis, the second stage of tool design, the third stage of programming, the fourth stage of tool testing, and the last stage of evaluation and conclusion.

g. Design validation
Validation is carried out to determine the shortcomings and weaknesses in the process of making electric steering gear design tools.

2. Research method phase II (Development)
   a. Product test design
   This product test design stage aims to determine the feasibility of Arduino microcontroller-based electric steering gear design products. If the product is not in accordance with expectations, the researcher will make improvements to the product
   b. Research subjects
   The subjects of this study were designed.
   c. Data collection techniques
   The data collection technique used in this study used questionnaires (questionnaires) and interviews.
   d. Research instruments
   The instruments used in this study were expert validation and cadet response questionnaires.
   e. Data analysis techniques

At this stage, the author will display the presentation of data. The presentation of data is a collection of information that can provide the possibility of drawing conclusions or verification and using the Guttman scale in the form of a checklist to get an affirmative answer.

FINDINGS AND DISCUSSION

Results should be clear and concise. The results should summarize (scientific) findings rather than providing data in great detail. Please highlight differences between your results or findings and the previous publications by other researchers.

Product Design

To continuously improve effectiveness and ease of use, this update aims to replace conventional control devices such as levers or steering wheels with smartphones connected via Wi-Fi modules. Thus, the ship operator will be able to set the direction of movement of the ship through a special application on a smartphone connected to the Wi-Fi module. Implementing this update is expected to provide ease of operation and more precise maneuverability in ship control.

Discussion

Tool Manufacturing And Steering Gear Electric Remote Control System Programming Demonstration

1. Preparing tools and materials
   This research uses cardboard as material to form the skeleton of the ship. After the ship's

frame is formed, gauze fibers, resins, and catalysts are used to strengthen and structure the ship's frame to make the ship of harder fiber materials. In this manufacturing process, tools such as scissors are used to cut cardboard, shooting glue to hold cardboard together, brushes are used to apply a mixture of resin and catalyst to the ship's body to glue gauze fibers, and sandpaper is used to flatten and smooth the ship's body. All of these tools are tools that are often used in the manufacture of this ship.

2. Making ship design and coloring of the ship's hull

The next step in manufacturing these props is to start with measurements and manual design sketches to form the hull. After that, cardboard is used to form the shape of the vessel, and subsequently, the ship's frame is made using gauze fibers. The ship's frame is then strengthened into fiber material by applying gauze fibers to the skeleton and fusing it with resin liquid that has been mixed with a catalyst. After that, give color to the body of the ship using a pilog. Before the coloring stage on the ship's hull, the designer gives putty to the untidy hull. The provision of putty aims so that the ship's hull does not leak into the water and that the coloring process is neater. After the putty process, the designer began to color the ship's body. At the bottom of the ship, the designer used red; the top of the ship used gray on the deck, and the designer's ship accommodation used white.

3. Control Panel and Tool Suite

In this design, the designer uses a smartphone as a controller connected to the Wi-Fi module on the Arduino ESP8266. At the tool circuit stage, the designer will combine a servo motor with a steering leaf and ESP8266 as a remote controller for the servo motor.

4. Steering Gear Machine Control System Assembly

In assembling a control system or electronic system, accuracy, accuracy, and precision are crucial. Designers use circuit boards as a foundation in the assembly process. The initial stages that the designer must perform are:

a. Control system
b. Liquid Crystal Display (LCD) Module
c. Step Down
d. Install Software

How Microcontroller-Based Electric Steering Gear Works

Electric Working System Steering Gear

The designer explained the working principle of the electric steering gear design with remote control of the steering engine. In this design, the designer made a remote controller of the steering engine controlled using an Arduino. The working principle of this design is as follows:

1. Electric Working System Steering Gear

The designer created an electric steering gear working system that is easy to understand. The working principle is that we can adjust and change the steering leaf of the ship according to our wishes so that we can know the position of our ship in relation to the position of other ships. By using this electric steering gear, the ship can move with the appropriate degree angle that we specify, making it easier to adjust the maneuvering of the ship to suit the needs and conditions around the ship.

2. Remote Control System

The designer makes updates in this remote control system by utilizing the Wi-Fi module as a controller signal. Remote control using this Wi-Fi module makes it easy for users to adjust the angle on the steering leaf. Simply by using a smartphone that has been connected to a microcontroller via Wi-Fi, we can easily set the desired degree angle on the servo motor. This simplifies the control process and allows for more flexible and convenient remote control.

First Stage I Test Results

The testing phase involves a process of testing and evaluation to verify the suitability of the system that has been made with the microcontroller system used. The main purpose is to evaluate whether the programs and inputs that have been entered into the system are appropriate or still require improvement. In the initial testing stage, there are several activities carried out by researchers, including:

1. Steering Gear Angle Program Testing
2. LCD Testing
3. Testing of Power Supply
4. Testing of Servo Motors

Second Stage II Test Results

After revising the first test, researchers proceeded to conduct the second stage of testing. The first revision stage is carried out to correct components that do not work according to the researchers' expectations. As a result of this revision, the design is better than before. In the second testing stage, an evaluation of the results of improvements made after the first testing stage is carried out. In this second stage, researchers carry out testing, namely:

1. Overall Testing
2. Expert Validation Testing

Product Improvement

At this stage, researchers make improvements to the design that has been made so that it is ready to be presented to Semarang pip cadets or to conduct tool demonstrations. These improvements include improvements to both the circuit and circuit placement, but in terms of finishing, researchers will focus on improving the placement of the circuit in the ship to make it easier to understand and resemble actual conditions. Some of the steps carried out in the finishing stage by researchers include:

1. Improvements to the layout
2. Component Layout Improvements

Product Discussion

The products made by researchers are the result of the innovation and development of electric steering gear used on ships. Researchers believe that the system can be further developed by utilizing current innovations and technological advances. Based on these observations, researchers were inspired to create innovation or development by making an electric steering gear design that uses a microcontroller and is equipped with a Wi-Fi module.

The purpose of this development is to make the ship's remote steering gear via a smartphone, which refers to the ability to control the ship's steering system using a smartphone as a remote control device. In this case, the ship's steering system is connected wirelessly or via a communication network to a smartphone that serves as a control interface. By using a smartphone as a means of control, the crew can control the movement of the ship's rudder remotely without

having to be near or inside the ship's control room. The crew can use special applications or control interfaces provided by the ship's steering system designer. Through a secure and encrypted connection, the crew can access steering control functions such as moving the steering wheel left or right, adjusting the steering level, or performing other maneuvers related to the steering of the ship. Information and commands sent via smartphone will be received by the ship's steering system and implemented on the physical system that controls the movement of the ship's rudder.

CONCLUSIONS

From the results of research and discussion that has been carried out in this thesis paper. Here are some conclusions that can be drawn:

1. In making this design, the materials used are fiberglass from cardboard and gauze fiber mixed with resin catalyst and various electronic components. The tools used for cutting materials are scissors and burrs. To punch holes in the fibers and make the steering shaft foundation and propeller shaft foundation, an electric drill is used. In order to avoid leakage on the ship, researchers glued using resins and catalysts throughout the ship's body, especially on the hull and body of the ship. In designing electronics, researchers use Arduino as the main component and several supporting components such as Wi-Fi modules, servo motors, breadboards, and step-downs. After that, coding is carried out to ensure the electronic system is functioning properly.
2. The workings of this design are quite simple; by setting how many degrees the angular position of the steering leaf is to be operated, the designer has made an update by combining remote control through the Wi-Fi module. This module is connected to a smartphone that serves as a replacement for the steering leaf control center. The operation of the tool is also quite easy, just by using an application on a smartphone that has been programmed according to the wishes of the designer.

Based on the conclusions previously described, there are several suggestions and recommendations that researchers can summarize as a guide in completing the design of electric steering gear with remote control via a microcontroller-based smartphone, as follows:

1. To achieve satisfactory design results according to the designer's expectations, intelligence, patience, and accuracy are needed in manufacturing. It is because the designer must deeply understand the schematic circuit as a first step in determining the components needed in the design. In the use of microcontroller bases with electronic circuits, a high level of accuracy and intelligence is needed in programming and assembling these components.
2. For cadets and students of the Semarang Shipping Science Polytechnic, it is recommended to use microcontroller-based steering gear electric prototype trainers with remote control via smartphones as an innovative, practical learning medium. The use of this tool is expected to increase understanding and skills in operating modern shipping equipment related to microcontroller technology and remote control.

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