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Design of a Lift Bridge Model on a Navigable River Using an Microkontroler ATMEGA 8

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Abstract

Today's technology has developed rapidly and rapidly, especially in the field of control electronics. However, the current transport bridge control system in Indonesia is still underdeveloped. The mindset of the Indonesian people tends to deify foreign products. The practicality of bringing in a tool and just installing the tool is one of the causes of the underdevelopment of the transport bridge control system in this country. Actually, Indonesian citizens are able to make these tools, especially since Indonesia is an archipelagic country and still uses water transportation facilities. Based on this in this final project, a miniature lift bridge simulation was designed and made using an ATMEGA 8 microcontroller. Supporting components so that the miniature lift bridge control system can work according to the desired design, including the ATMEGA 8 microcontroller as a data controller that changes the LED lights, and moves the servo motor to lift or close the bridge, when the ship hits the infrared sensor. From the results and analysis, it is found that the output voltage produced by the circuit is 5 volts, and the speed of the ship so that the sensor can be detected should not be more than 2.6 cm/s.

Keywords*: Microcontroller, Atmega 8, Servo Motor.*

1. Introduction

Along with the increasingly rapid development of the era, the need for efficiency effectiveness is prioritized in various fields. This has encouraged creativity and innovation in the field of technology to create a tool that is more effective and efficient. The development of technology today can be seen that many tools have been created in order to provide convenience to people who carry out work.

According to Tintin Chandra Assembly is a low-level programming language used in programming computers, microprocessors, micro controllers, and other programmable devices. Assembly language is an assembly language which is often called machine language and this language is a low level language. In 1957, a team led by John W. Backus succeeded in developing a new language that was more focused on the need to analyze numerical problems. The resulting extension of assembly language is a file with the extension COM and EXE, which is a measure of the area that causes programming abnormalities in assembler. COM extension, means that at most the file will only take up 64 kilobytes of area which is called 1 segment,

Microcontroller ATMEGA 8 is a microcontroller chip produced by Atmel Inc. It is part of Intel's MCS-51 family. ATMEGA 8 has basic features that are quite complete for an input-output processing. The language used by ATMEGA 8 is not much different from the instruction set on the Intel microprocessor. Microcontroller is a compact computer system, can replace the function of a computer in controlling work and design is much

more concise than a computer. With a very small size, the microcontroller can be used on equipment that is mobile.

C language is a programming language that can be said to be between a low-level language and a high-level language. Low-level language means machine-oriented language, for example assembler language, a language written with code that is understood by machines only, therefore it is only used for those who program microprocessors, and high-level language is human-oriented, and is used on computers.

Based on the research of microcontroller-based automatic bridges, where the system designed is in the form of an automatic bridge that can move up automatically which is controlled by a series of instructions (programs).

2. Methodology

The waterfall method or what is often called the waterfall method is often called the classic life cycle, where it describes a systematic and sequential approach to software development, starting with the specification of user requirements, then continuing through the planning stages.), modeling (modeling), construction (construction), and delivery of the system to customers / users (deployment), which ends with support for the complete software produced (Pressman, 2012).

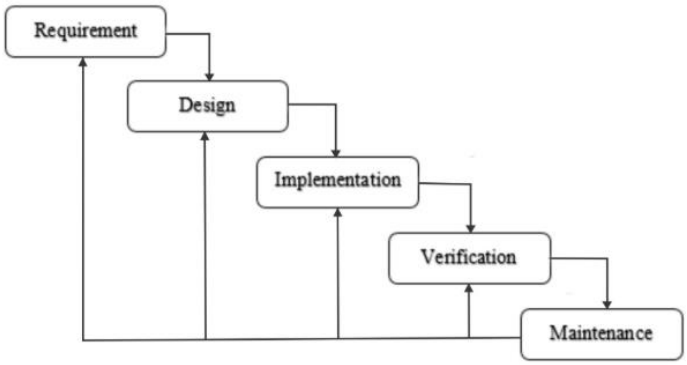

Figure 1. Waterfall Method

In its development, the waterfall method has several sequential stages, namely: requirements (needs analysis), system design (system design), Coding (coding) & Testing (testing), Program implementation, maintenance

3. Results

In the design of this automatic lift bridge simulation tool, there are 10 main circuit blocks. Sensor 1 serves to detect ships that will pass the bridge. Sensor 2 serves to notify the microcontroller that the ship has crossed the bridge. The output of the sensor will be amplified by the signal amplifier before entering the microcontroller. The results of the strengthening of the sensor that have been processed by the signal amplifier will be sent by the microcontroller.

The ATMEGA 8 microcontroller which is the brain of the whole system functions to process all incoming data. The stepper motor driver is used to control the stepper motor. Stepper motors are used to lift bridges and close crosswalks. The alarm serves to notify that the ship is crossing the bridge.

3.1. Power Supply Design (PSA)

This circuit serves to supply voltage to the entire existing circuit. The PSA circuit made consists of two outputs, namely 5 volts and 12 volts, 5 volts output is used to supply voltage to the entire circuit and 12 volts is used to supply voltage to the stepper motor in the power supply circuit shown in Figure 3.1 below:

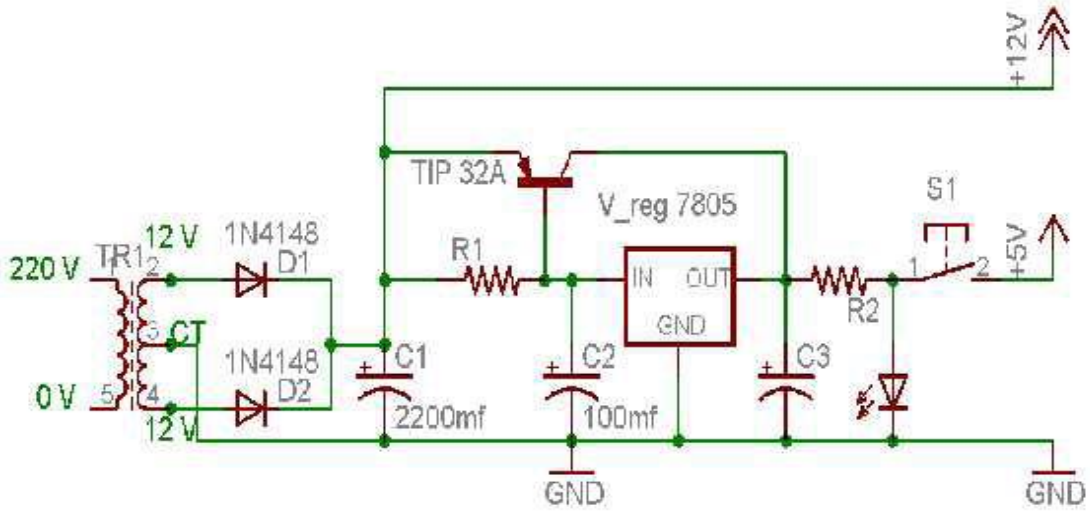

Figure 2. Power Supply Circuit (PSA)

The CT transformer is a step-down transformer that functions to lower the voltage from 220 volts AC to 12 volts AC. Then 12 volts AC will be rectified using two diodes, then 12 volts DC will be rectified by a 2200 F capacitor. A 5 volt voltage regulator (LM7805CT) is used so that the resulting output remains 5 volts even though there is a change in the input voltage. The LED is only an indicator when the PSA is turned on. The PNP TIP 32 transistor here serves to supply current in the event of a current shortage in the circuit, so that the voltage regulator (LM7805CT) will not heat up when the circuit requires a large enough current. The 12 volt DC voltage is directly taken from the output of 2 rectifier diodes.

3.2. ATMEGA 8 . Microcontroller Circuit

This circuit serves as the control center of the entire existing system. The microcontroller circuit is shown in the following figure:

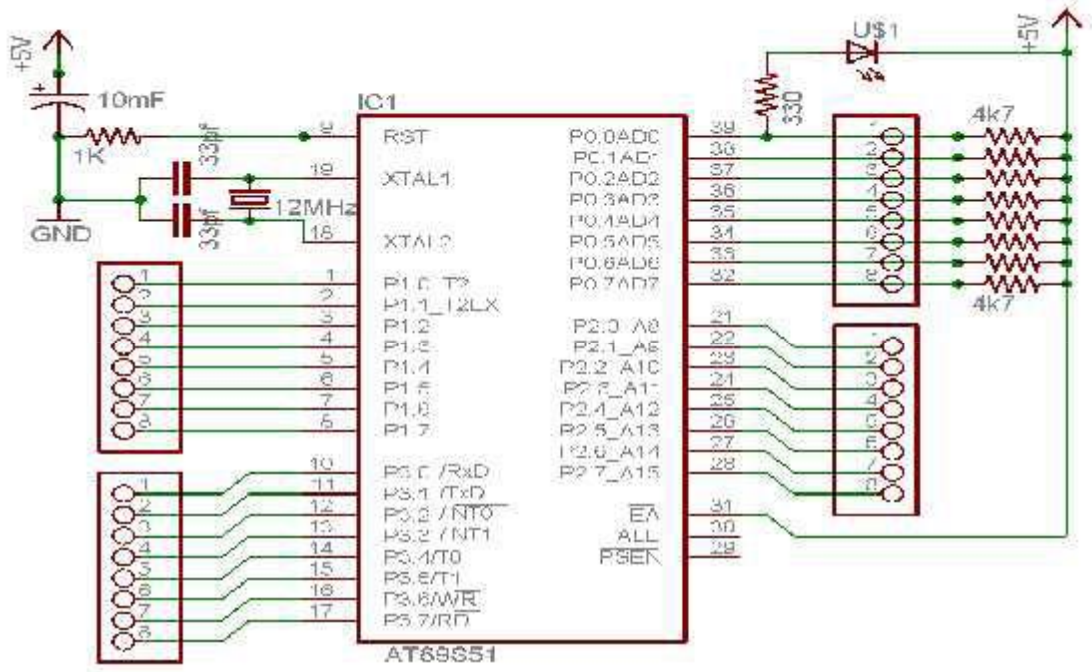

Figure 3. ATMEGA 8 . Microcontroller Circuit

Pin 31 External Access Enable (EA) is set to high (H). This is done because the AT89S8253 microcontroller does not use external memory. Pins 18 and 19 are connected to a 12 MHz XTAL and a 33 pF capacitor. XTAL will affect the speed of the AT89S8253 microcontroller in executing every command in the program. Pin 9 is the reset input (active high). The transition pulse from low to high will reset this microcontroller. Pins 32 to 39 are Port 0 which is an 8 bit open collector I/O line/bus which can also be used as a multiplex low address bus and data bus during access to external program memory. At port 0, each pin is connected to a 4k7 ohm resistor. The 4k7 ohm resistor connected to port 0 functions as a pull up so that the output of the microcontroller can trigger the transistor. Pins 1 to 8 are port 1. Pins 21 to 28 are port 2. And Pins 10 to 17 are port 3. Pin 39 which is P0.0 is connected to a 330 ohm resistor and an LED. This is done only to test whether the minimum circuit of the AT89S8253 microcontroller is working or not. By providing a simple program on the microcontroller, it can be seen whether the minimum circuit is working properly or not. If the LED connected to Pin 39 has worked according to the command given, then the minimum circuit is ready for use. Pin 20 is ground connected to ground on the power supply. Pin 40 is a positive voltage source connected to + 5 volts from the power supply. Pin 39 which is P0.0 is connected to a 330 ohm resistor and an LED. This is done only to test whether the minimum circuit of the AT89S8253 microcontroller is working or not. By providing a simple program on the microcontroller, it can be seen whether the minimum circuit is working properly or not. If the LED connected to Pin 39 has worked according to the command given, then the minimum circuit is ready for use. Pin 20 is ground connected to ground on the power supply. Pin 40 is a positive voltage source connected to + 5 volts from the power supply. Pin 39 which is P0.0 is connected to a 330 ohm resistor and an LED. This is done only to test whether the minimum circuit of the AT89S8253 microcontroller is working or not. By providing a simple program on the microcontroller, it can be seen whether the

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3.3. Sensor Circuit

To be able to detect passing ships, this tool is equipped with 2 motion sensors. These two motion sensors have the same circuit, only the placement is different. Each sensor uses 1 infrared transmitter and a photodiode. This sensor utilizes the reflection from the infrared transmitter received by the photodiode. Two infrared transmitters are used on each sensor to make the reflected signal stronger, so that the sensor position is not too close.

The infrared transmitter circuit looks like the picture below:

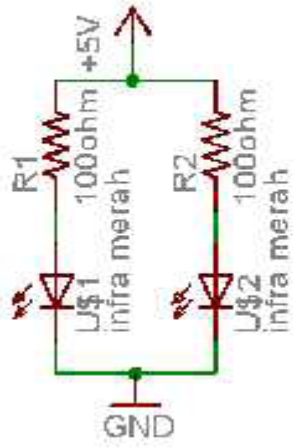

Figure 4. Infrared Transmitter Circuit (www.google.com).

Each beam received by the photodiode in Figure 3.4 will be processed and converted into digital data, so that when the photodiode gets a beam from the infrared transmitter, it will send a low signal to the AT89S52 microcontroller. Thus the microcontroller can detect sensors that send low signals and take action to lift and lower the bridge.

In the above circuit, 2 infrared LEDs are used in parallel, thus the intensity emitted by the infrared is getting stronger, because it is a combination of infrared LEDs. The resistor used is 100 ohms so that the current flowing in each infrared LED is:

R = Vi
then : 5 0, 05 50

100
i VA or mA
R

With the amount of current flowing into the infrared LED, the intensity of the infrared emission will be stronger, which causes the reflection distance to be farther away. The reflection from the infrared light will be received by the photodiode, then it will be processed by the receiver circuit to produce a certain signal, where if the photodiode receives a reflection of infrared light, the output of this receiver circuit will issue a logic low (0), but if the photodiode does not receive reflected light infrared, then the output of the receiver circuit will issue logic high (1). The photodiode is operated in reverse bias, where this photodiode will have a resistance of about 15 to 20 Mohm if it is not exposed to infrared light, and its resistance will change to about 80 to 300 Kohm when exposed to infrared light depending on the intensity that hits it. The greater the intensity, the smaller the resistance.

In the above circuit, the output of the photodiode is fed to the base of the NPN C945 transistor, this means that to saturate the transistor, the voltage that comes out of the photodiode must be greater than 0.7 volts. This condition will be fulfilled if the photodiode gets infrared light, the analysis is as follows: If no infrared ray hits the photodiode, then the resistance on the photodiode is 15 Mohm. Vout will be fed to the base of transistor C945, so the transistor is not saturated. If there is infrared light that hits the photodiode, then the resistance on the photodiode is 300 Kohm. Vout will be fed to the base of the transistor C945, because the voltage is greater then the transistor will saturate. The emitter transistor C945 is inputted to the Op Amp LM 358 for amplification. LM358 is an amplifier IC with two Op Amps. In the first Op Amp the input voltage will be amplified to a maximum of 100 times the gain. This gain can be adjusted by adjusting the resistance on the potentiometer. The Op Amp output has been amplified to a maximum of 100 times. Thus the reinforcement can be adjusted as desired. This LED will light up if the sensor receives infrared light,

3.4. Stepper Motor Control Circuit

In order to be able to lift and lower the bridge / crossbar, a stepper motor controller is needed. This circuit is used to control the motor so that by closing and lifting the bridge we can control the bridge if a ship passes by. This circuit uses a stepper motor and stepper driver. The stepper motor functions to open and close the bridge as well as open and close the bar and the stepper driver functions to control the stepper motor. The stepper motor controller circuit can be seen in the following figure:

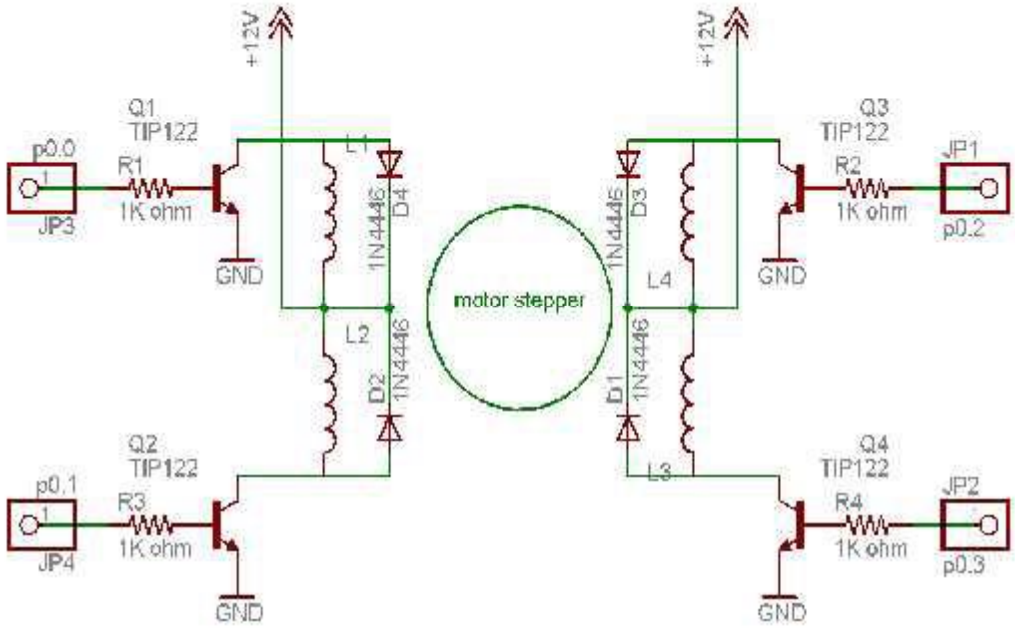

Figure 5. Stepper Motor Control Circuit

This driver serves to rotate the stepper motor clockwise or counterclockwise. This circuit will be controlled by the ATMEGA 8 microcontroller. So by giving alternately high signals to the input of the stepper motor driver circuit, the movement of the stepper motor can be controlled by the ATMEGA 8 microcontroller. This stepper motor driver circuit consists of four inputs and four outputs, where each input is connected to the ATMEGA 8 microcontroller and the output is connected to a stepper motor. This circuit will work to rotate the stepper motor if it is given a high signal (1) alternately on the 4 inputs.

This circuit consists of 4 NPN TIP 122 transistors. Each transistor is connected to P0.0, P0.1, P0.2 and P0.3 on the ATMEGA 8 microcontroller. The base of each transistor is given a resistance of 10 Kohm to limit the current that goes into the transistor. The collector is connected to the coil contained in the stepper motor, then the coil is connected to a 12 volt voltage source and the emitter is connected to ground. If P0.0 is given a logic high (1), which means the base on the TIP 122 transistor gets a voltage of 5 volts, then the transistor will be active. This will cause the collector to be connected to the emitter, so that the collector gets a voltage of 0 volts from ground. This causes current to flow from the 12 volt voltage source to the coil, so the coil will produce a magnetic field. This magnetic field will attract the metal in the motor, so that the motor leads to the coil that has the magnetic field. If then P0.0 is given a logic low (0), which means the transistor is not active and there is no current flowing in the coil, so there is no magnetic field in the coil. And on the other hand P0.1 is given a logic high (1), so the coil connected to P0.1 will produce a magnetic field. Then the motor will switch to the coil connected to the P0.1. Then if a logic high is applied alternately to the input of the stepper motor driver, the stepper motor will rotate in the direction of the logic high (1) given to the input. To rotate in the opposite direction to the previous direction,

3.5. Buzzer Circuit Design

This buzzer circuit serves to provide a warning in the form of an alarm tone if a ship passes by. The circuit is as shown below:

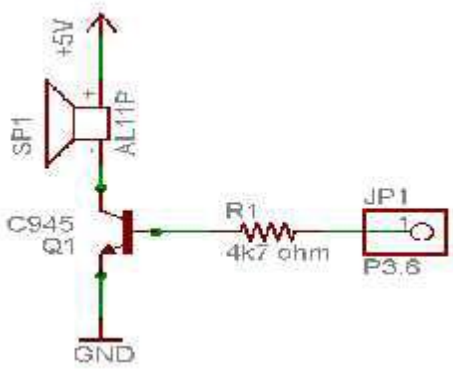

Figure 6. Buzzer Circuit

In this tool, the alarm used is a 5 volt buzzer. This buzzer will sound if the positive is connected to a positive voltage source and the negative is connected to ground. In the circuit above, the transistor functions as an electronic switch that can turn the buzzer on and off. From the picture it can be seen that the negative buzzer is connected to the collector of the NPN transistor (2SC945), this means that if the transistor is in an active state, the collector will be connected to the emitter where the emitter is directly connected to ground which causes the voltage at the collector to be 0 volts, this situation will result in a buzzer. sounds. Conversely, if the transistor is not active, then the collector is not connected to the emitter, so the voltage at the collector becomes 5 volts, this situation causes the buzzer to turn off. The transistor used in the above circuit is an NPN type transistor, this type of transistor will activate if the voltage at the base is greater than 0.7 volts. The 4.7 Kohm resistor on the base is useful for limiting the current entering the base so that the transistor is not damaged.

4. Conclusion

A stepper motor is a drive that has good accuracy. Because it can be adjusted the angle and rotation of the rotation. So this tool is needed if the desired number of rotations is right. For example on a disk drive or printer motor. Microcontroller is a chip or IC in which there is a processor and flash memory that can be read/written up to 1000 times, so development costs are cheap because it can be erased and then refilled as needed. The language used to program the ATMEGA 8 microcontroller IC is assembly language for the MCS-51 number 51 is the number of instructions in this language there are only 51 instructions but the instructions used here are 10 instructions.

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