CCTV Camera Controller Simulation Using Arduino Uno and Joystick

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Abstract. CCTV or Closed Circuit Television is a tool that can help improve the security system and minimize theft both in private homes and public places. But not all CCTVs are equipped with drive motors in all directions and can be used to monitor at an angle that is difficult to reach by CCTV. So that it can minimize the use of the number of CCTVs used to reach every difficult angle seen by CCTV. In this study a simulation tool was designed that combines CCTV with Arduino UNO circuits, Joysticks, Servo Motors, DC Motors, and Relays so that CCTV can move vertically and horizontally. With the development of this simulation system, it is hoped that it can more efficiently cost the cost of moving CCTV, with a webcam monitoring system and controlled movement through the joystick. And with this simulation can be an alternative to CCTV systems.

1. Introduction
CCTV (Closed Circuit Television) are technologies that have been widely used by the public. This device can be found in almost every corner of a place or location such as schools, campuses, corporate buildings, shopping buildings, homes, restaurants, and so on. The main purpose of this device is created as a tool to monitor a location so that it can improve its security. Of all these CCTV devices, not all have camera drive motors because the price is expensive. Many previous studies conducted on CCTV devices. In the study discussed about the design of Arduino controls the camera to control the surveillance camera using an Android smartphone. Where the control is using IP camera streamer with panning control [1]. In another study discussed the design of drivers in CCTV cameras using Arduino and Internet Protocol [2]. For this reason, we need to design a motor controller controller on a CCTV camera using a joystick. This design is expected to be an alternative to the use of driving motors in CCTV with a more affordable cost compared to commercial CCTV which is quite expensive.

The design of CCTV control camera simulation used to move the camera, in this study used a webcam camera as a substitute for CCTV cameras, by combining Arduino Uno devices, Joy Sticks, and Servo Motors. So that the camera can move perpendicularly and / or sideways.

It is expected that the design of this simulation can develop CCTV systems so that they can move in all directions and can be used to monitor focus angles that are difficult to reach by CCTV in general. The main objective of this research is to develop a CCTV system that is simple and inexpensive but has a performance that is not inferior to Commercial CCTV.
2. Literature Review
In this section will explain about literature in this study

2.1. Simulation
Simulation is an imitation of the process of a condition or system from time to time. Used to analyze and analyze the functions of a system. Simulation uses extensive methods and applications of behavioral imaging from real systems [3].

2.2. Close Circuit Television (CCTV)
CCTV is a digital video camera device that is used to capture images or videos that are connected to the screen monitor in a particular room or place. The purpose is to be able to monitor the situation and condition of a particular place. Many CCTV cameras have used modern technology systems. The current CCTV camera system can be operated or controlled via a handheld Personal Computer or Telephone, and can be monitored from anywhere and anytime as long as it is connected to an internet connection [4].

2.3. Arduino Uno
Arduino Uno is a microcontroller board based on Atmega328. Arduino Uno already contains everything needed to support the microcontroller and easily connects it to a computer with a USB cable or supplies it with an AC to DC adapter or uses a battery to get it started. ATmega328 on Arduino Uno comes with a bootloader that allows us to upload new code to ATmega328 without using an external hardware program [5].

2.4. Joystick
Remote controller (in this case the Remote Joystick) is an electronic device that can control robots. Joystick Remote is a part that interacts directly with the user by giving commands to move the robot in forward, backward, turn left, turn right in the process of lifting an item [6].

2.5. DC Motor
Motor Direct Current (DC) is a type of motor that is driven by using DC voltage / direct current. DC motor consists of stator and rotor. Stator is a permanent magnet while the rotor is a coil. If the coil on the rotor is electrified, a magnetic field will emerge, which will react with the stator's magnetic field, resulting in the rotor rotating. In the motor there is also a reduction gear to increase motor torque [6].

2.6. Relay
Relay is a switch that is controlled by current. The relay has a low voltage coil which is wrapped around a core. Relays are needed in electronic circuits as executors as well as interfaces between loads and electronic control systems with different power supply systems. Relays can be used to control AC motors with DC control circuits or other loads with different voltage sources between control circuit voltage and load voltage.[7]

3. Methodology
in this section we will discuss how to design and implement the tools in this study.

3.1. Hardware and Software Design
The purpose of this design is to plan or design hardware in accordance with the specifications and work methods of the system that is made so that it is expected to be able to streamline time, cost and effort.
In designing software in this study the instructions are arranged into a program to control the devices designed. Where this program will be placed in the Arduino device as the center of the device designed.
3.2. System Design

3.2.1 Block Diagram

The design of the application of the control camera simulation using the ATMega328 microcontroller can be explained in the following system block diagram:

![Block Diagram of Controller Camera](image)

In the block diagram above, it is explained that the joystick as a control camera and power supply simulation controller gives voltage to the microcontroller and then is processed by the microcontroller to provide output on the LCD screen, control the servo motor and give a signal to the relay circuit to provide DC voltage so that the DC motor and the servo motor can drive the control camera. The relay circuit is also given a 12 volt power supply.

3.2.2 Flowchart

This flowchart aims to facilitate the building of systems and devices in this study.

![Flowchart of System](image)

3.2.3 Merging All Component Design

In this control camera simulation uses a combination of several simple components by combining the minimum system circuit into the Arduino system circuit so that it can provide the desired input and output. In combining all components of the control camera simulation circuit, it has been adjusted to the pin pin in the Arduino, the pin pin is coupled optimally and there are several pins that are jumped.
4. Result and Discussion
In this section we will discuss the results of the design that is working on and testing it.

4.1. Servo Motor Assembly
In assembling the control camera simulation, a servo motor is used as a camera rotation tool in addition to a servo motor capable of holding the camera load, the servo motor that is used to move is only 180° so there will be no condition where the cable will be twisted. In the picture below, there are two servo motors that are attached to different positions so that the servo motor can provide right-left and top-down movements. The servo motor is given a plate to hold the camera so that the camera can be stable on the servo motor.

4.2. DC Motor Assembly
In the picture below you can see the results of the assembly, where the DC motor is assisted to move the control camera on the back and forth rails, when forward commands on the joystick the DC motor will rotate the belt strap associated with the control camera to move forward, and when the joystick gives a command back then the DC motor will turn the belt strap back and the control camera moves backwards.
4.3. Relay Assembly
Relay circuits are used to drain a voltage source to drive a DC motor based on commands from the microcontroller, besides that the relay also functions as an insulator between the electrical control circuit and the DC electric motor in other words the relay is also used as a DC motor driver.

4.4. Joystick assembly
The design of this joystick controls the control camera back and forth, right-left and up and down by providing input to Arduino and Arduino giving commands to the servo motor and DC motor to provide movement to the control camera. In this control camera simulation, use two joysticks as shown in the following picture.

4.5. Camera Layout Assembly
In this control camera simulation, the camera is attached to the plate attached to the servo motor that has been in order, so the camera can be stable attached to the servo motor circuit so that it can move right and left and up and down like the following picture.
4.6. Overall Circuit
After completing the design, the entire set of devices will be combined with the camera has been attached to the servo motor connected to the belt strap linked with the DC motor which will backward and forward moved. Then connected with Arduino, as well as the circuit on the LCD, relay and joystick. All connected as a whole and put on a board as the cassis.

4.7. System Testing
Testing of the control camera simulation using ATMega328 microcontroller with several stages including the following:
1. Testing the program for the joystick values that are inputted and displayed on the LCD screen
2. Testing the program for the left camera movement
3. Testing the program for the motion of the camera right
4. Testing the program against the motion of the camera up
5. Testing the program for camera movements down

4.8. Program Testing for the Value of the Joystick Input and Display on the LCD Screen
In testing the joystick input given to the microcontroller provides a value, thus to control the servo motor against the microcontroller only replaces the value on the joystick input so the servo motor will move according to the value that will be set with the input from the joystick and will be displayed on the LCD screen.
4.9. Program Testing to Camera Motion Up
In this test, when the joystick1 is moved upward and the joystick1 gives impulse worth 100 and 50 on the microcontroller, the servo motor will move so that the camera will point up.

4.10. Program Testing to Camera Motion Down
In this test, when the joystick1 is moved upward and the joystick1 gives impulses worth 0 and 50 on the microcontroller, the servo motor will move so that the camera will point down.

4.11. Program Testing to Camera Motion Left
In this test, when the joystick1 is moved upward and the joystick1 gives impulse worth 49 and 0 on the microcontroller, the servo motor will move so that the camera will lead to the left.
Figure 13. LCD Display from Joystick1
Left

4.12. Program Testing to Camera Motion Right
In this test, when the joystick1 is moved upward and the joystick1 gives impulse worth 49 and 100 on the microcontroller, the servo motor will move so that the camera will lead to the right.

Figure 14. LCD Input Display from Joystick1 Right

5. Conclusions
From the results of this study we can conclude several things including:
1. Has succeeded in developing a control camera simulation that can drive CCTV so that it can move vertically and horizontally so that it can monitor at a point of focus that is not affordable CCTV.
2. By using the Arduino UNO-based ATMega328 microcontroller the design is easier and more efficient so that if you want to add a new idea design simply determine the pin to be used.
3. The servo motor that is suitable for simulation of this control camera is a servo motor which can only rotate 180 °, because if used a servo motor that rotates continuously can cause the cable on the camera or servo motor to become entangled.
4. Control of the control camera uses a very balanced joystick because the joystick can control in all directions.

References
[1] A. E. U. Salam, R. S. Sadjad, and M. Tajrian, “Pengontrolan webcam untuk aplikasi sistem monitoring ruangan,” 2012, vol. 6, pp. 978–979.
[2] R. D. H, “IP Camera Streamer dengan Kontrol Panning Berbasis Arduino Uno Menggunakan Smartphone Android,” 2014.
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