Arduino based bi-functional Automated Bridge System

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Abstract *Many bridge systems have been presented but there are still some limitations in terms of the high cost. 0ne function and difficulty of use that is not satisfactorily reliable and cannot be developed. There are two portions in this system. They are toll gates control system and auto bridge plates system. Arduino Uno is also used to control the stepper motor to lift bridges plates and servo motors are used to control tollgates. Therefore, the aim of this research project was to design and develop a prototype for an auto bridge system. It has a user-friendly interface, scalable and reliable by using an integrated system of hardware and software. The hardware such as Arduino Uno, servo motors, stepper motors, variable registers and wires are utilized to develop the prototype of an auto bridge system.*

**KEYWORDS:** *Auto Bridge, Arduino Uno, Servo Motor, stepper motor, registers*

1. Introduction

Nowadays, increasing traffic volume causes congestions commonly around the toll gate of highway. Therefore, the new technique is urgently required to reform the problem of congestions. Automated bridge system is one of the methods to solve the above conditions. The automated bridge system is composed of several subsystems. Automated bridge system can bring the several sectors for toll gates as saving time and reducing the human workers. Develop the prototype model, which reproduces the operation states of various toll gate systems: passing time and waiting time. The main objective is to implement a low cost acquisition system intended for control applications using the Arduino prototyping platform.

2. Experiment

2.1 Experiment apparatus

My native is Rakhine state in Myanmar. It is coastal region and it has plenty of rivers. Many bridge systems have been presented but only one transport, high way. This system is provided bi-functional transport, high way and water way .There is can be used by various vehicles above the bridge and ships and boats can be passed under the bridge. The use of automated bridges system in many metropolitan cities would be an efficient step towards the overcrowding of the city highways in heavy congestion of traffic. It provided with two toll gates at each end of the bridge. Toll gate is made with Servo motor to lift up and down of toll gate's hand. While vehicles pass the bridge toll gate's hand is lifted, water way is closed. When toll gate's hand is down, it doesn't allow passing the vehicle. Bridge is provided joining by two bridge plates in the middle. One end of bridge is provided with two stepper motors to lift up and down the bridge plates. When both toll gates are closed, the signal LED is on and the water way is opened by lifting the bridge plates from two ends of the bridges. Opening the water way, the vehicles aren't allowed to pass above the bridge by closing the toll gate and ships can pass through the bridge plates. This project is made by using cardboards and system only. As we all know, transportation is the strength of our country's economy. My project paper will support to carry many loads and passengers by the ships and the boats. The system has been evaluated with the previous works and it was demonstrated to obtain some feedback on the prototype. The testing of the prototype demonstrated that the system was an integrated practical and easy to use and any new device could easily be installed into the system. The aim of this research project has been achieved successfully.
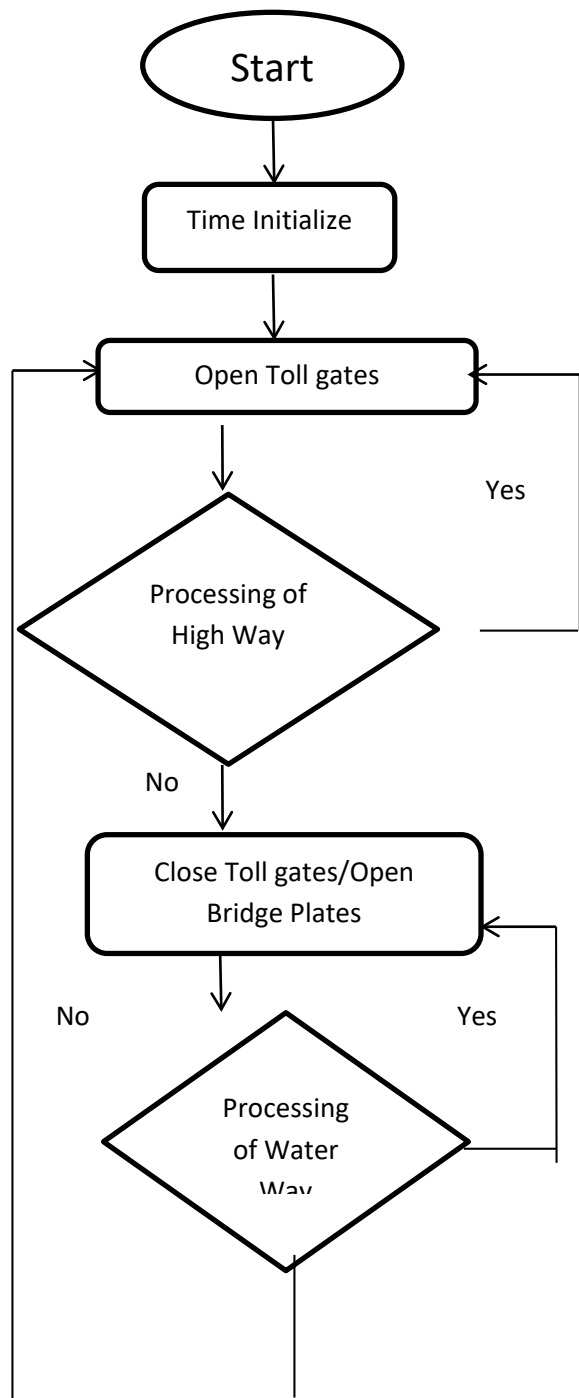
3. Stepper motor

1. Arduino Uno Board

Arduino is an open source, computer hardware and software Company. A user community that designs and manufactures microcontroller kits for building digital devices. Interactive objects that can be sensed and control objects in the physical world. The project's products are distributed as open-source hardware and software. Arduino Uno is embedded board used in our system. It is an open source hardware and software for developers. It is basically easy to code and easy to use. It is used when same program is to be performed under nested loops. Arduino is connected with Computer attach at toll booth. [1]

Software Components Arduino programming: The purpose of the Arduino programming is to control the operation of the Arduino microcontroller. This program is fed into the printed circuit board through the ports in order to perform required task. It is simple and it controls the overall process on the basis of the conditions given in the program.

Hardware Components

Microcontroller: The Arduino microcontroller UNO is the brain of the entire system. The controller receives the commands from servo motor and stepper motor. [4]

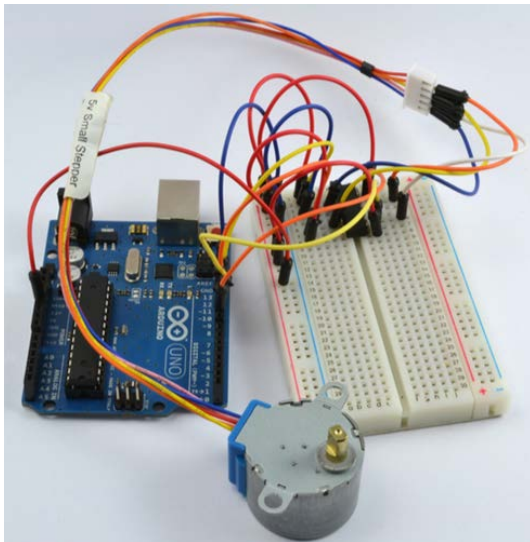
Figure2. Arduino Uno board

2. Servo Motor

Servo motors have several distinct advantages over steppers. They can generate high torque over a wide speed range on demand, and are available in wider torque ranges and higher voltages (up to 480 Vac). They respond to disturbances with a torque much greater than their continuous capability and use only the power required to accomplish the commanded motion and are compact. Two servo motors are used to lift up and down the tollgate's hand in this project.

Figure1. Flowchart of the System

2.1.1 Hardware Modules

The major components of the gate control system are as follow:

1. Arduino Uno Board

2. Servo Motor

Figure3. Servo Motor

3. Stepper motor

Figure4. Connection of Stepper motor and Arduino

The stepper motor is an electronic device that converts digital pulses into mechanical shaft rotation. The most significant advantage of stepper motor is its ability to be accurately controlled in an open loop system. It is simple motor used to rotate the barrier which is connected to the Arduino board. It can be access by using specific servo library available

The advantages of stepper motor are –

➢ Low cost and high reliability

➢ High torque at low speeds and a simple

➢ Rugged construction that operates in almost any environment

There are two types of stepper motor. They are unipolar stepper motor and bipolar stepper motor. The unipolar stepper motor is used for this system because its winding is made relatively simple with the communication circuit than bipolar
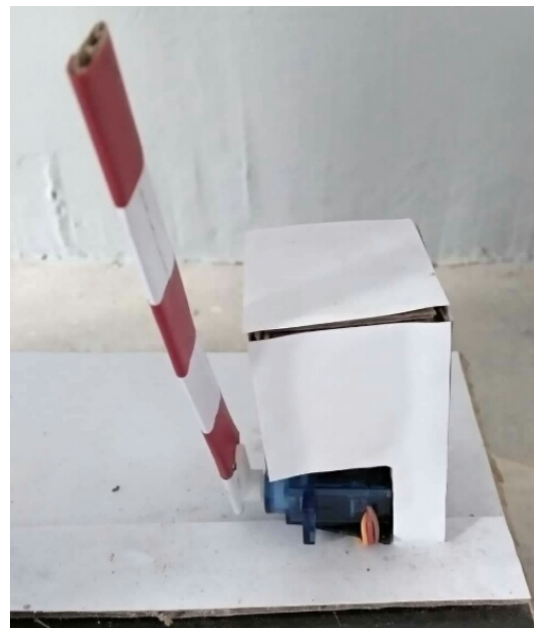
stepper motor in open loop system. The supply voltage for motor is 12V. This motor is used to lift up and down of bridge plates.

Figure5. Circuit connection of Arduino, Stepper motor and Servo motor

Figure6. Auto bridge system

Figure7. Toll gate with Servo motor

3. Analysis

The main aim of this paper was to develop an auto bridge system by implementing of stepper motor and servo motor. Servo motor is light but it give out high output power. This means that it lift heavy power. This project paper used two servo motors for toll gate and two bridge plates are lifted with 4 stepper motors. The servo motors are connected directly to Arduino Uno by connecting the wires of the servo motor to Arduino Uno. The servo motor is principally connected by three wires to Arduino Uno: ground, power and signal. The ground wire was connected to the ground pins of the Arduino board and the power wire was connected to the 5-volt power pin. The signal wire of servo motor connected to the digital Input/ Output pins. The whole system was assembled in auto bridge prototype which was designed to accommodate all of the Hardware components. [2]

3.1 Discussion

In the first, each of Bridge plates is connected with servo motor to lift the bridge plates. Lifting is quickly and no systematically in the first. Later is become systematically. So, I prepared this project by replacing with two Stepper motors. Stepper motors have several major advantages over servo systems. They are typically lower cost, have common NEMA mountings, offer lower torque options, require less costly cabling, and their open loop motion control component makes machine integration simplistic and provides ease-of-use to end users. It is all about utilizing these technologies with balance to achieve the desired process performance for a given machine design while balancing cost versus the capability of the required mechanism. Machine designers shouldn't limit utilization of steppers or servos by a predetermined mindset or comfort level, but learn where each technology works best for controlling a specific mechanism and process to be performed. Servo motors are extremely repeatable because they run closed loop. But steppers can be just as repeatable in many applications, especially when running in one direction. [5]

4. Conclusion

In conclusion, the main goal of this project was to design of an auto bridge system by the overcrowding of the city highways and waterway in heavy congestion of traffic by using an Arduino Uno, two servo motors, two stepper motors and it has been achieved. As we all know, transportation is the strength of our country's economy. This research project also represented a good beginning point to develop an auto bridge system that could be someday met at low cost that is easy to use and reliable. It strengthens the argument made in this research that due to the advancement of technology; it is possible to improve systems at low cost and in two transport way which required a relatively low level of maintenance. The

testing of the prototype demonstrated that the system was easily used and any new devices that are reliable, scalable for development and of the very low cost compared to the current products available in the market can be installed on it. The overall cost of the system was approximately $50. It was determined as the price of each component that has been utilized in this project. Nevertheless the price of the prototype will be reduced when it is presented in the market so all individuals; especially in developing countries can take advantage. System testing of software and hardware has been applied to conduct on a complete. The integrated system also to evaluate the system's compliance with its specific requirements. And the result was all stages work fine. Finally, this research provides useful lessons and information that could be utilized to support future research. This prototype of the system is designed as to be simple, low cost and easy to use. Nevertheless, the prototype still requires further development and improvement in terms of the functionality of the system.

Acknowledgements

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[5]Balancing Technology & Capability for the best Performance Servo Motor and Stepper Motor