A PROJECT REPORT ON

AUTOMATION OF DRAWBRIDGE USING PLC

Submitted in partial fulfilment of the requirements

Of the degree of

Bachelor of Engineering

In

Electronics and Telecommunication

By

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2018-19

CERTIFICATE

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This is to certify that the project entitled **"Automation of Drawbridge using PLC"** is a bonafide work of **Ansari Muzammil Mohd Amin (16DET74), Phansopkar Muzammil Maswood (16DET111), Anas Amin Qureshi (16DET112), Solkar Akil Zikriya (16DET132)** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of Bachelor of Engineering in Department of Electronics and Telecommunication Engineering.

Supervisor	Examiner
Head of Department	Director

Project Report Approval for Bachelor of Engineering

This project entitled **"Automation of Drawbridge Using PLC "**by **Ansari Muzammil Mohd Amin (16DET74), Phansopkar Muzammil Maswood (16DET111), Anas Amin Qureshi (16DET112), Solkar Akil Zikriya (16DET132)** is approved for the degree of **Bachelor of Engineering in Electronics and Telecommunication**.

Examiner

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Date:

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Declaration

We declare that this written submission represents my ideas in my own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

An automatic or movable bridge is a special type of bridge that allow passage (usually) for boats or large ships. In this project bridge is fully automated by using PLC. The main objective of this project is to allow passage to huge gigantic cargo ships on the canals or lagoons because for them bridge can't be built because of their shape and size. The idea is to automate the process of ship detection, opening or closing of a bridge, controlling the signals. The purpose of the research is to replace the manual system which is currently used. The ABB PLC is used to mechanize the system. Sensors such as Proximity are used to provide input to the system. And motor such as DC motor serves as an output. Ladder diagram as a programming language is used to control the whole system between the input and output. With the help of IR sensor and Proximity sensor the arrival and leaving of the system is Monitored and bridge is operated accordingly.

Keywords: PLC, Drawbridge Modal, Proximity Sensor, IR Sensor, Ladder Logic.

INDEX

LIST OF FIGURES

CHAPTER NO: 01

INTRODUCTION

1 INTRODUCTION

1.1 Project Overview

A bridge over a navigable waterway must allow boats and ships to cross its path, usually by being tall enough to allow them to sail underneath it. Sometimes it is impractical to build a bridge high enough; for example, it may rise too steeply or block the view of an important landmark. In such cases, the bridge can be designed so it can be easily moved out of the way for vessels that are too large to sail under it. The type of movable bridge that most people think of as a draw bridge is similar to those that spanned medieval castle moats. Technically called "bascule bridges" from the French word for seesaw, they may open at one end and lift to one side (single leaf) or open in the middle and lift to both sides (double leaf).

Another common type of movable bridge is the vertical lift span, in which the moveable section is supported at both ends and is raised vertically like an elevator. Re-tractable bridges are made so the movable span slides back underneath an adjacent section of the bridge. Swing bridges are supported on vertical pivots, and the moveable span rotates horizontally to open the bridge. Movable bridges are relatively rare because they are more expensive to operate and maintain than stationary bridges.

Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. Various types of PLCs by various companies are available today like Siemens; ABB etc. The Automatic Bridge Control System consists of three important parts. The first part is the PLC controller and second part is hardware. These usually comprise of prototype model of bridge. The third part is the sensor. The sensor checks the presence of Ship. This project is to design and construct a DRAWBRIDGE using a programmable logic controller.

1.2 Literature Survey

A Survey on Automation of Drawbridge Using PLC, in the A movable bridge or drawbridge is a type of bridge that can be raised to allow the smooth passage of boats or ships beneath it. In this paper a fully automated bridge is proposed by using PLC there by replacing the manual system which is currently used. The idea is to automate the process of ship detection, opening or closing of the bridge, controlling the signals .

Design: There is a unique structure for each drawbridge designed for its particular location and traffic needs .The most common type is the bascule type beyond half a dozen different design concepts. In double-leaf or four-leaf (a double-leaf bridge with separate leaves for each direction of vehicular traffic) bascule bridges, each leaf can be raised and lowered independently. By counterbalancing each leaf with a compact weight on the opposite side of the pivot axle (turn-on), the energy required for rising and lower the bascule leaves is greatly reduced. This counterweight might be located above the roadway and allowed to pivot below the roadway as the bridge is raised, or it might be located bellow the roadway and allowed to descend into a basement level (often well below the waterline) as the bridge opens

Description of PLC: The first Programmable Logic Controller, PLC was developed by a group of engineer sat General Motors in 1968. It was developed for the purpose that the company was looking for an alternative to replace complex relay control system. As defined by EN 61131-1, the term "programmable logic controller" is a digitally operating electronic system which uses a programmable memory for the internal storage of user-oriented instructions

Hardware

In prototype design Ultrasonic sensors are used, for prototype it is not possible to design an induction loop. As the basic function of induction loop in Intelligent Traffic Control System is used to provide an interrupt signal to controller unit. We use Ultrasonic sensors rather than induction loops. In our design, Ultrasonic sensors provide an interrupt signal to controller unit. In case 0when vehicle reaches in front of sensors, then it provides an interrupt.

1.3 SYSTEM DESIGN

The system deals with controlling the process of opening and closing of bridge automatically with the help of PLC. The system is designed by using sensors such as IR sensors, and motors such as DC motors. Figure 1 shows the 2 dimensional view of the system model. It consists if the leaves of the bascule type bridge and the supporting structures.

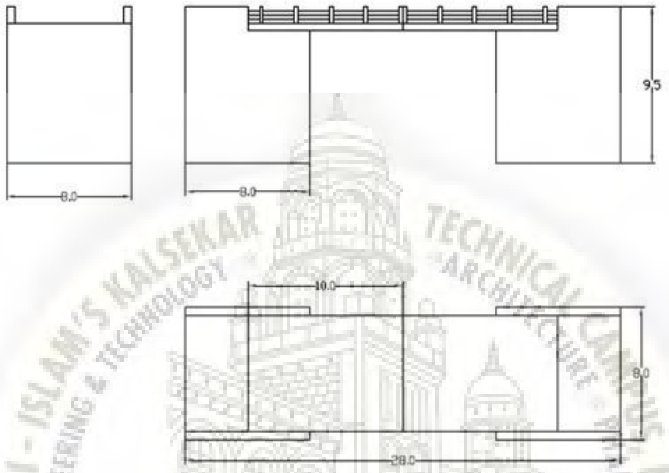

Fig 1. 2D view of the drawbridge model.

The proximity sensors are placed on either side of the bridge which detects the ship arrival and departure respectively. The IR sensors are used to provide an interrupt signal to the PLC unit when vehicles are detected on the bridge. The DC motors are used to open and close the bridges It is connected to a rack and pinion arrangement where the pinion movement facilitates the upward and downward movement of the bridge. LEDs are installed in the signal poles on either side of bridge and across the bridge for signaling of ship and vehicles respectively. Buzzer is used for alarming in case of emergency situations (if any vehicles or people do not cross the bridge in the given time) to notify the control authorities and to alarm before the bridge opens.

1.4 Real world Design:

Each draw bridge is a unique structure designed for its particular location and traffic needs. There are at least half a dozen different design concepts, but the most common is the bascule type. In double-leaf or four-leaf (a double-leaf Bridge with separate leaves for each direction of vehicular traffic) bascule bridges, each leaf can be raised and lowered independently. The energy required rising and lower the bascule leaves is greatly reduced by counterbalancing each Leaf with a compact weight on the opposite side of the pivot axle (turn-on). In various bascule designs, this counterweight might be located above the roadway and allowed to pivot below the roadway as the bridge is raised ,or it might be located below the roadway and allowed to descend into a basement level (often well below the waterline)as the bridge opens. It might be located adjacent to the turn-on or, for greater leverage, be set back a few yards (meters). As an example, each pair of 500-ton (450-metric-ton) leaves on the Casco Bay Bridge is balanced with an
800-ton (720-metric-ton) counterweight. The lift mechanism is usually a rack-and-pinion gear arrangement driven by electric motor

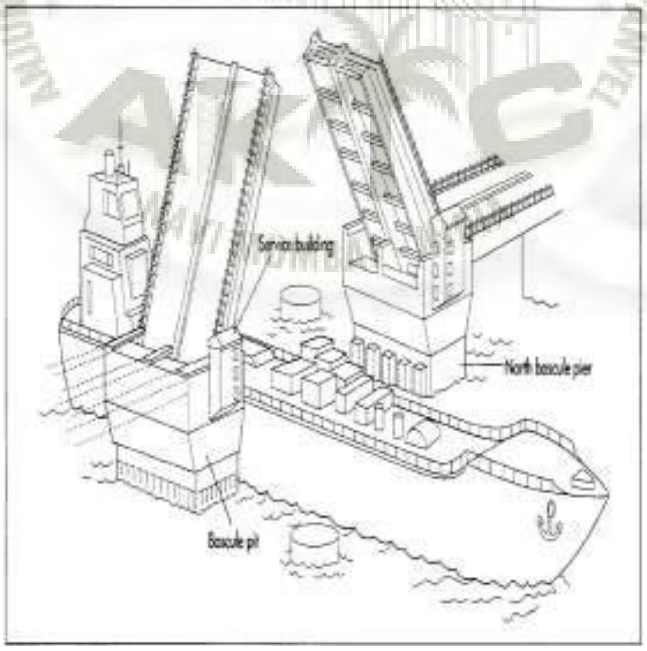

Fig 2. Real World Design

CHAPTER NO: 02

HARDWARE SPECIFICATION

2 HARDWARE SPECIFICATION

2.1 Proximity Sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive proximity sensor or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between the sensor and the sensed object.

Proximity sensors are also used in machine vibration monitoring to measure the variation in distance between a shaft and its support bearing. This is common in large steam turbines, compressors, and motors that use sleeve-type bearings.

International Electro technical Commission (IEC) 60947-5-2 defines the technical details of proximity sensors.

Fig 3.Proximity Sensor

2.2 Ultrasonic Sensor

Features:

1. Operating voltage: +5V.
2. Theoretical Measuring Distance: 2cm to 450cm.
3. Practical Measuring Distance: 2cm to 80cm.
4. Accuracy: 3mm.
5. Measuring angle covered: <15.
6. Operating Current: <15mA.
7. Operating Frequency: 40Hz.

Working:

Vcc, Trigger, Echo and Ground are the pins of Ultrasonic Sensors. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed X Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Fig 4.Ultrasonic Sensor

2.3 IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

IR Sensor Circuit Diagram and Working Principle:

An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components:

1. LM358 IC 2 IR transmitter and receiver pair

2. Resistors of the range of kilo ohms.

3. Variable resistors.

4. LED (Light Emitting Diode).

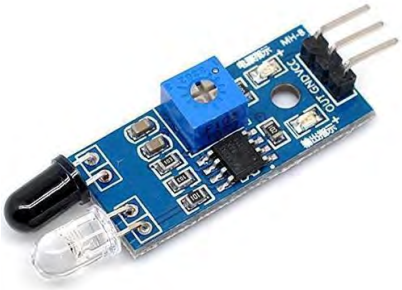

Fig 5. IR Sensor

The transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

2.4 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The rst relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts. Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

Fig 6. Relay

2.5 Power Supply

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting o the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control.

2.6 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration it consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

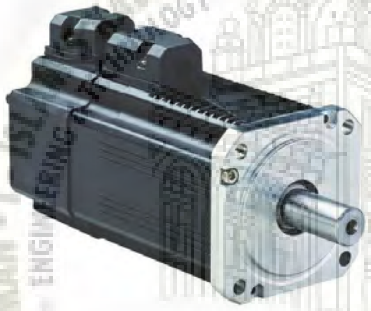

Fig 7. Servo Motor

Mechanism:

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

The motor is paired with some type of encoder to provide position and speed feed-back. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

2.7 DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct cur-rent electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Fig 8. DC Motor

Signal Pole:

Signal pole is used to indicate vehicle to stop. When ship would be detected, red light would be ON to indicate vehicle to stop because bridge will be about to open and when will ship pass through bridge, so after that bridge is closed then Green lights is turned ON again.

CHAPTER NO: 03

SOFTWARE SPECIFICATION

3 SOFTWARE SPECIFICATIONS

3.1 SCADA:

SCADA is a central control system that includes controller network interfaces, input / output, communication equipment and **software**. **Wonderware** "**In Touch**" provides a unified integrated view of all your controls and **information** resources.

Wonderware is a brand of industrial software sold by Aveva. Wonderware was part of Invensys plc, and Invensys plc was acquired in January 2014 by Schneider Electric. Invensys plc was formed in 1999 by the merger of BTR plc and Siebe plc, and Wonderware was acquired by Siebe plc in 1998.

Wonderware software is used in diverse industries, including: Automotive Assembly, Facilities Management, Food and Beverage, CPG, Mining and Metals, Power, Oil and Gas, Chemicals, Energy, and Water and Wastewater.

Wonderware employed an outrageous marketing blitz in the conservative industry for factory operations.

Wonderware is the global leader in human machine interface (HMI),SCADA and real-time operations management software Wonderware solution enable production and industrial operation software .Wonderware solution enable production and industrial operation to synchronize with business objectives to achieve speed ,flexibility and sustained profitability. Wonderware software delivers significant cost benefits for designing, building, deploying and maintaining robust application for manufacturing and infrastructure operation.

It provides basic input output conditions as per project based on scada. It also allows to program for the fault conditions and the process will be fully automated.

Eg of Scripting in Wonderware InTouch-

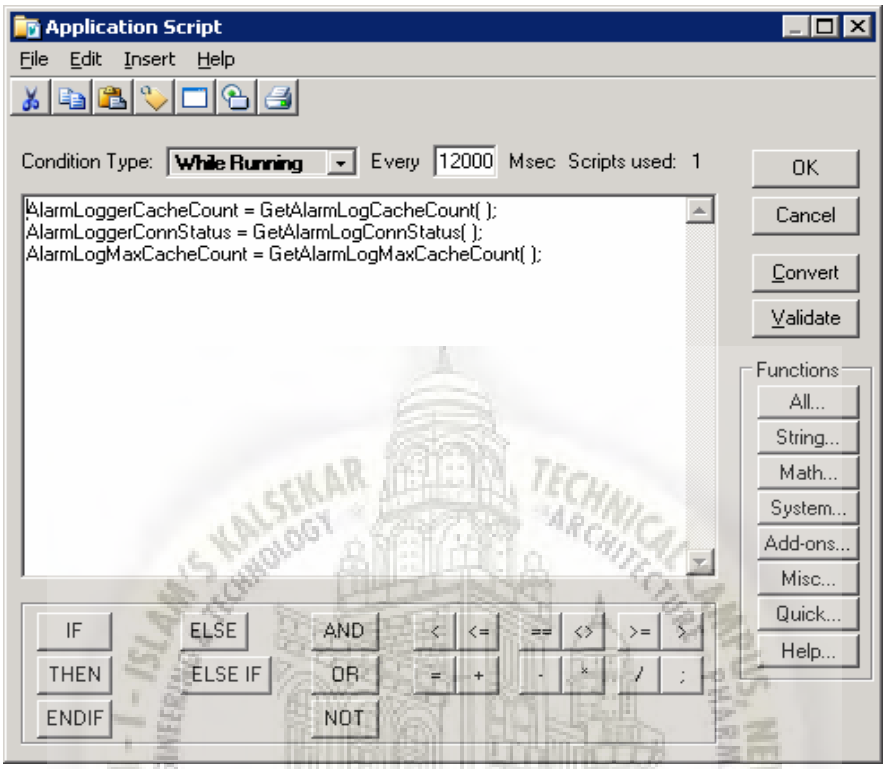

Fig 9. Scripting of Wonderware InTouch

Eg of Wonderware InTouch software diagram-

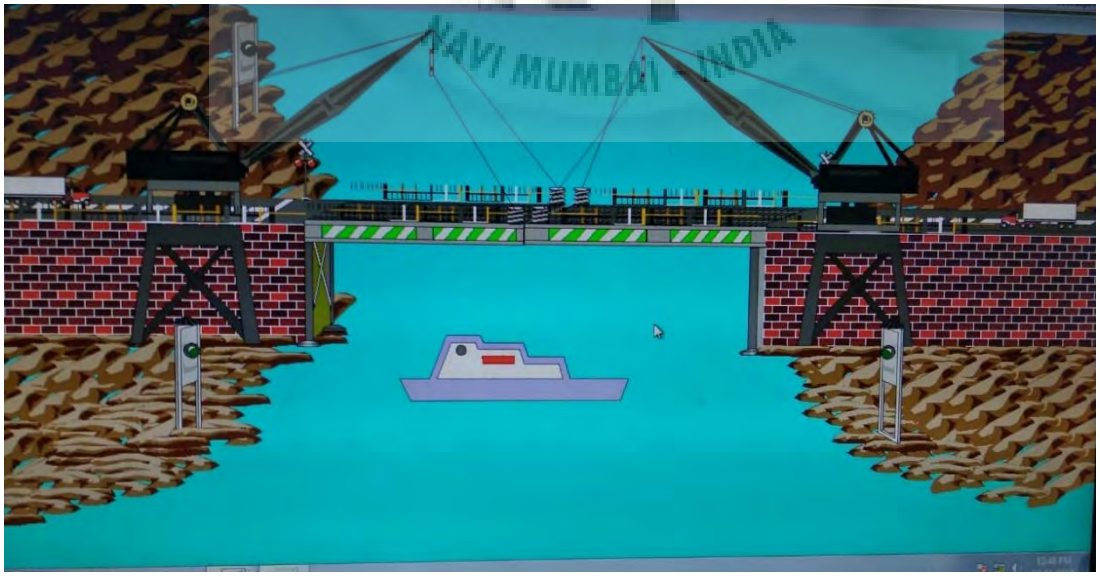

Fig 10. Wonderware Software Diagram.

3.2 RSLOGIX:

The RSLogix™ family of IEC-1131-compliant ladder logic programming packages helps you maximize performance, save project development time, and improve productivity. This family of products has been developed to operate on Microsoft Windows® operating systems. These RSLogix products share:

- Flexible, easy-to-use editing features
- Common look-and-feel
- Diagnostics and troubleshooting tools
- Powerful, time-saving features and functionality

3.3 RSLINX:

Major RSLinx benefits include:

1. **Routing:** RSLinx Classic 2.x provides a user-friendly graphical interface for navigating through our network. This includes routing over an office Ethernet network through a ControlLogix Gateway to get to our control networks and devices on the plant floor.

2. **Graphical Interface:** *RSWho* is the network browse interface providing a single window to view all configured network drivers. The multi-pane window allows navigation through network hierarchy in the left pane while RSWho displaying device icons along with their status in the right pane.

3. **Data Table Monitors:** RSLinx can be used to view data values in a PLC-5, SLC-5, MicroLogix, or ControlLogix processor. For RSLinx Data Table Monitor a PLC-5 / SLC-5 / MicroLogix device, select a data table file to view from a list of available data table files in the controller. For a ControlLogix processor, view tag information in a hierarchical list as the tags are defined in the target device. Multiple data monitor windows can be displayed at the same time providing an effective trouble-shooting tool. Data Monitor functionality is only available with RSLinx Professional and FactoryTalk Gateway.

4. **Ladder Viewers:** RSLinx includes an extremely valuable Ladder Viewer for PLC-5, SLC-5, or MicroLogix controller. Based on the RSLogix family of programming software, it allows viewing of the ladder code including symbols, address descriptions and rung comments for an effective and complete diagnostic tool when used on your HMI or data collection station on the production floor. Ladder Viewer functionality is only available with RSLinx Professional and FactoryTalk Gateway.

CHAPTER NO: 04

PROPOSED SYSTEM

4. PROPOSED SYSTEM

4.1 BLOCK DIAGRAM

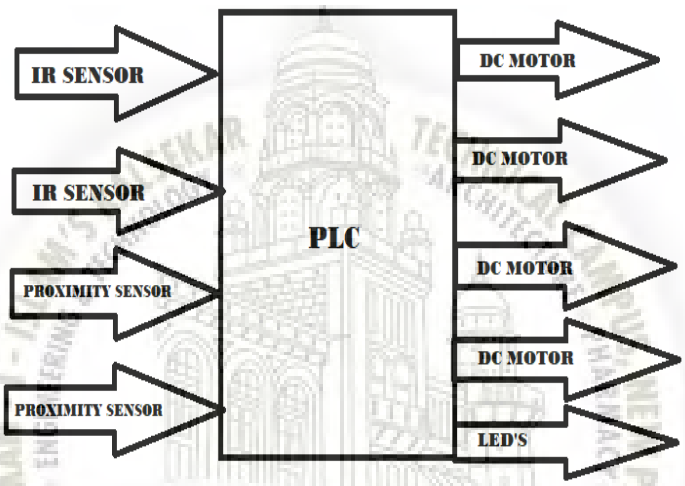

Fig 11. Block Diagram

CHAPTER NO: 05
FLOW CHART

5 Flow Chart

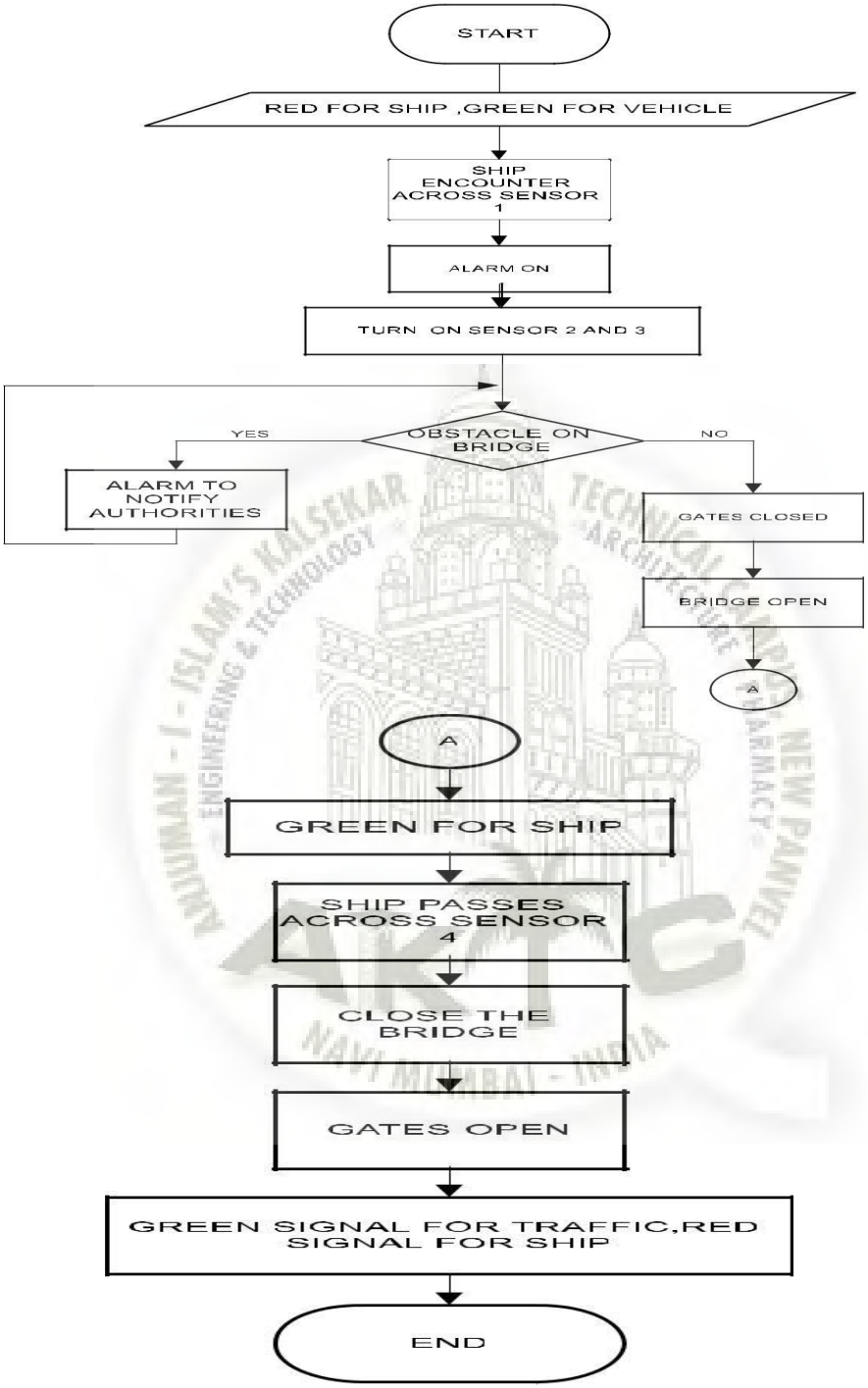

Fig 13. Flowchart of the system

5.1 WORKING:

The working of the system is represented in the form of flowchart shown in figure. The system deals with controlling the process of opening and closing of bridge automatically with the help of PLC. The ship would be detected by proximity Sensors located at the either side of the bridge. After the detection of the ship the buzzer is on for clearing the bridge. The IR sensors detect the presence of any obstacles on the bridge before opening the bridge. If there is no obstacle present on the bridge then the red signal will be given to the vehicles and the bridge will be opened. If any obstacle is present on the bridge then red signal will be given to the ship and when the obstacle is cleared the bridge will open and the ship will be passed. Once the ship is passed the ship will be detected by the sensor on the opposite side of the bridge and after that the bridge will be closed and green signal will be given to the vehicles and the traffic will also be controlled.

CHAPTER NO: 06
ADVANTAGES AND DISADVANTAGES

6. ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES:

1. You can have free passage of any height when the drawbridge is up regardless of the level the road is on.
2. You can always close a drawbridge (by cutting the chains used to draw the bridge up)
3. It is relatively simple to construct and - given the gap is short enough - can be constructed from one side, i.e. a log across a stream is a sort of drawbridge, but without the chains.
4. You don't need a long lead-up to clear a given height as with suspension bridges.
5. Opening the bridges effectively cuts the passage (except for a few movies) thereby isolating the bridged parts.
6. Bridge can be balanced with counterweights making it easy to open and close

6.2 DISADVANTAGES:

1. The weight of the bridge is proportional to the length, the torque quickly becomes problematic as the length extends,
2. Us it is better to have 2 opposing drawbridges than a single twice as long. Thus there is a limit to the gap your drawbridge can reasonably span.
3. When the bridge chains have been cut, the bridge will remain closed for a long time.
4. Time to open/close the bridge (obstructs traffic in both directions) - I don't think modern drawbridges open a full 90 degrees. This further narrows the gap of free passage.
5. If balancing the bridge with a counterweight, the lever and anchor/fulcrum will have to be able to support a massive load.
6. Moving parts are always susceptible to malfunction
7. You cannot run wires or pipes the length of the bridge - but you can have rails, but mind the fit at the fulcrum. This means you will have to run wires from either side (or along the gaps floor) to light up the bridge on both sides

6.3 APPLICATIONS

Industrial Application:

Using Industrial Shields, it is possible to get smart and flexible installations, Data acquisition can be sent to a database, and analysed to find an efficient system. It is not necessary to pay licenses, and your efforts can be focused on the project. Those PLC's can be expanded as your needs. You can send data to the cloud and connect the automation line to the Industrial Internet of things.

6.4 FUTURE SCOPE

1. SCADA (supervisory control and data acquisition) implementation can be done for monitoring all the process.

2. CCTV camera can be utilized for more accuracy in the ship detection.

3. This process can be implemented between twin cities divided by river, lagoons making it as effective measure of transport

CHAPTER NO: 07

CONCLUSION

Conclusion:

We presented designing of a PLC based control system for automatic opening and closing of bridge. The automated process efficiently reduces the man power required for the process and also increases the efficiency. The use of PLC for controlling action of the system effectively leads to intelligent system which requires less time compared to human and this system also ensures safety.

CHAPTER NO: 08

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