Automation of Drawbridge Model Using Raspberry Pi

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Abstract--- **In this fast and materialized world, automation is a necessity as it provides flexibility, ease of operation, and operational safety. This paper presents automation on controlling the movement of a drawbridge and detection of ships using the video surveillance for ports thereby replacing the manual system which is currently used. Also, the status of the bridge will be uploaded on Cloud. This paper can be divided into three sections; vessel detection, operation of the bridge, and uploadation of data on the cloud. Picamera is used to monitor the arrival and leaving of the ships. For detection, Opencv and Python are used. Raspberry Pi is used to mechanize the whole system. For the operation of a bridge, a servo motor is used as an actuator and a driver circuit is used to control it. PIR Sensor and LED are used to provide input to the system and the servo motor serves as an output. Python is used as a programming language to control the whole system between input and output.**

Index Terms— **Raspberry Pi, Vessel Detection, Cloud, Opencv**

I. INTRODUCTION

In today's world, transportation plays a very important role in the daily life of human beings, whether it is air transportation, land transportation, or water transportation. A bridge is built between land separated by river bodies to connect and provide the path. But over the last few decades, water transportation has become one of the most effective means of transporting goods. So it becomes impossible for cargo ships and other large-sized marine vessels to pass through that path. Though bridges are built tall enough it is impractical to build them above a specific height as its design would be very expensive and it might block an important landmark's view. Thus movable bridges are designed to overcome this problem. Movable bridges provide a path for both vehicles and marine vessels. There are different types of movable bridges. One such type is the drawbridge. It is designed to change its position to provide a path for marine vessels like ships. Also, the bridge permits a passage for small size boats to pass through even if it is not completely opened. The drawbridge is similar to the wooden bridges used in medieval castles. The bridge is operated by pushing buttons or by pulling levers by an inspector. The monitoring of ships and traffic on the bridge is done manually. But this is not safe as it might cause accidents and it is difficult to monitor the ships and vehicles all the time.

Fig 1.1 Drawbridge

So this paper proposes to eliminate all these disadvantages by designing a fully automated system. The main purpose of the system is to replace the manual system and to increase safety. Raspberry Pi is used to automate electronic devices and mechanize the whole system. It monitors the input and control output according to the computer program. The vessels are monitored by a survelliance camera and for detection the frame differencing method is used. To check the presence of a vehicle on the bridge a PIR sensor is used. A traffic signal is used to halt the traffic and a light signal is provided to the ships if PIR detects any presence on the bridge. A servo motor will open the bridge at a specific angle and driver circuit is used to drive the motor. The status of the bridge and data of PIR is continuously uploaded on the cloud.

II. LITERATURE SURVEY

[1]In one of his papers, Muhammad Arshad Khattak et al interfaced sensors with PLC to design an intelligent traffic control system. The system detects the presence of vehicles within a range and the traffic signal reacts accordingly. This system was an attempt to solve the problem of traffic congestion.

[2]F. Necati Catbas,Masoud Malekzadeh, and Tung Khuc published a report titled "Movable Bridge Maintenance Monitoring". In this paper, a system was designed to track the maintenance and performance of the system. It tracks the behavior and condition of several electronic components. Different machine learning methods and statistical analysis are developed to track the operation of the components.

[3]Natalia Wawrzyniak, Tomasz Hyla, and Adrian Popik in their paper 'Vessel Detection and Tracking Method Based on Video Surveillance' presents a method to detect and monitor .the ships using a video stream. The experiment was carried out in variable light and weather conditions.

III. METHODOLOGY

The working of this system can be divided into 3 parts:
1. Detection of marine vessels
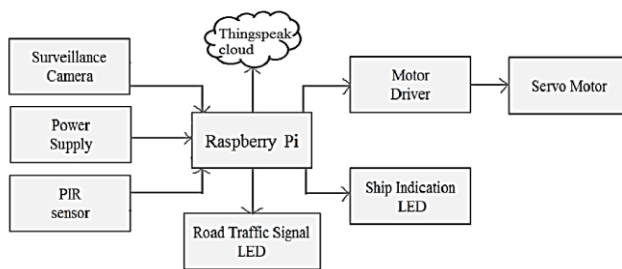2. Operation of the bridge
3. Data uploadation on cloud

Fig3.1 Block Diagram

a. Detection of marine vessels

A camera will monitor and capture the frames of the ships approaching the bridge. The ships in the frames are detected using the frame differencing technique. [4]OpenCV is used as an image processing platform. It has built-in functions to open the camera and capture the frames. After the frame is captured it is converted to a gray frame. The frame is blurred for smoothing and accuracy. The current frame is subtracted from the initial frame. The resulting frame is further filtered by changing the threshold value and by finding pixel contours in it. The small ships can easily pass through the arch of the bridge. So there is no need to detect the smaller-sized ships. The concept of contour area is used for customizing the rectangular bounding box covering the region of maximum displacement for each object. Thus only larger ships will get detected.

b. Operation of the bridge

Once a ship is detected the Raspberry Pi will generate a corresponding signal to halt the traffic on the bridge.

Raspberry Pi is a minicomputer and many sensors and motors can be connected to it through GPIO pins. A PIR sensor is used to check the presence of humans or any vehicle on the bridge. If the PIR sensor detects any presence it will signal Raspberry Pi and an indication signal is provided to the ship to slow down. Only if the output of the PIR sensor is zero a high signal is given to the driver circuit L293D. The relative signal is further transmitted to the servo motor which operates the opening and closing of the bridge.

c. Uploading data on cloud

The status of the bridge is continuously uploaded on the cloud. Also, the data of the PIR sensor is uploaded to the cloud so that the whole system can be easily monitored at the base station. Thing Speak is used for visualizing and inspecting live data streams on the cloud.

IV. COMPONENTS

Essential hardware components for this project are listed here. Raspberry Pi 3 Model B is used to automate hydraulic bridge which has 1.2 GHz 64-bit quad core ARM Cortex-A53 processor, 40-pin GPIO header, 10/100 BaseT Ethernet socket, Bluetooth, SD card support, The Raspberry Pi Camera Modules are official products from the Raspberry Pi Foundation which is helpful to capture images of ships coming towards the bridge. The resolution of this module is up to 12megapixel. Subsequently PIR sensors, LED's, Motor driver and Servo motor is used.

Where PIR sensor is used to detect vehicles are present on the bridge or not, They are small in size, low cost, low-power, easy to use. This sensor required power typically up to 5V. Sensing range is less than 180 degree and within 10 meters. Red color led and Yellow color led required forward voltage up to 1.6 - 2.0 VF and 2.1 - 2.2 VF respectively. The L293D is used as a Motor Driver IC which is efficient to run DC motors. Output current requirement is 600mA, and voltage range is from 4.8V to 6.5V, but most commonly they are operated at +5V, Operating speed is up to 0.17 s/60°.

With appropriate hardware, right software is required too. Throughout the project multiple softwares are used to perform different tasks. Proteus is a software tool used for drawing basic electronic circuit design. It is used for schematic design and connection reference purposes. OS is loaded into Raspberry Pi to make it ready for operation using Etcher software. Etcher is a free software used for writing image files and flashing operating system into SD card of Raspberry Pi. Putty is used for file transfer applications. It is an open source ssh protocol software used for remotely connecting display devices to Raspberry Pi. It helps to give commands to the Raspberry Pi. Having the correct IP address of Raspberry Pi connected on the

same network is important to make a right connection. So IP scanner is a tool used in networking, here used for getting the correct IP address of Raspberry Pi. After feeding the correct IP address for Raspberry Pi login, putty can successfully make connections between local display device and Raspberry Pi. VNC viewer is software which uses remote frame buffer protocol. Using VNC viewer, Raspberry Pi desktop is shared to the local display unit for viewing purpose and operation. Once all connections are established, programming is done to mechanize the whole system using Thonny.
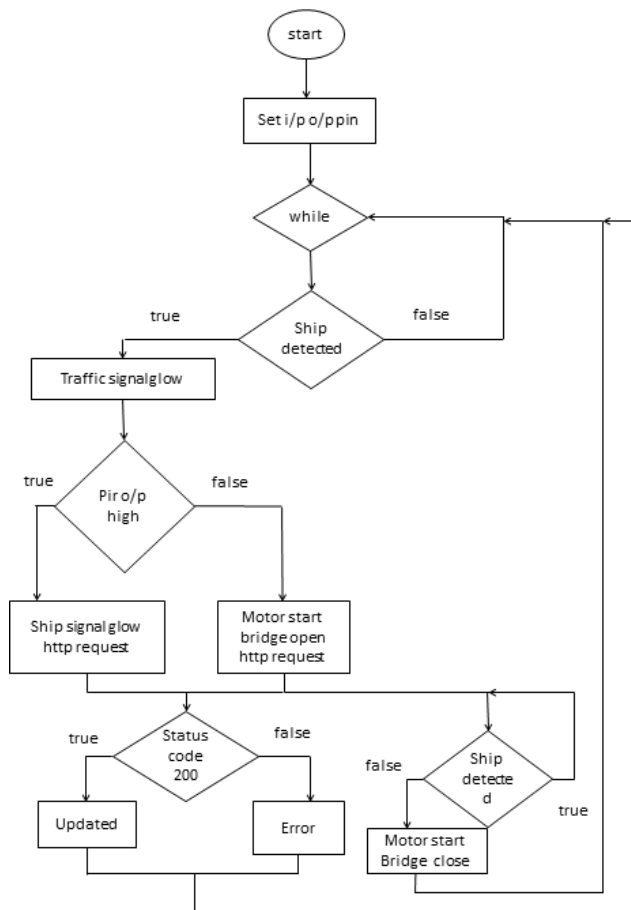
V. FLOWCHART

Fig 5.1 Flowchart
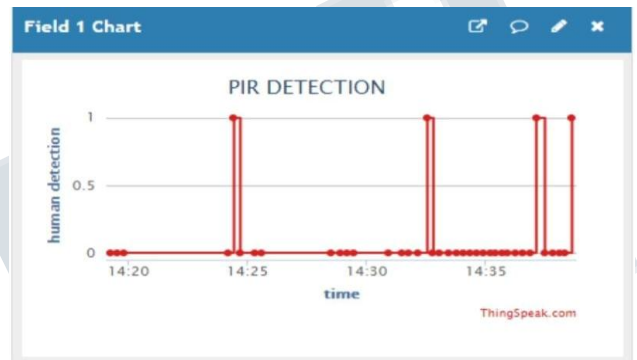
VI. RESULT

Fig 5.2 LED and PIR connected to Raspberry Pi

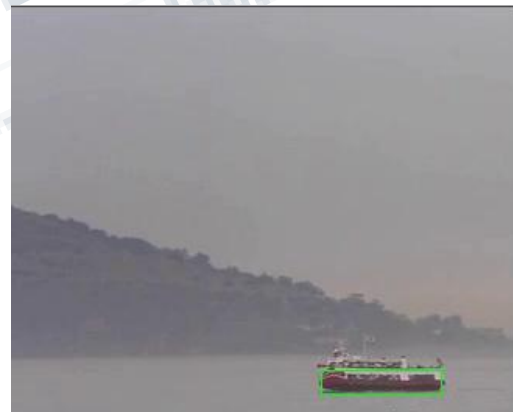**Fig 5.3 Graph of PIR sensor status on Thingspeak**
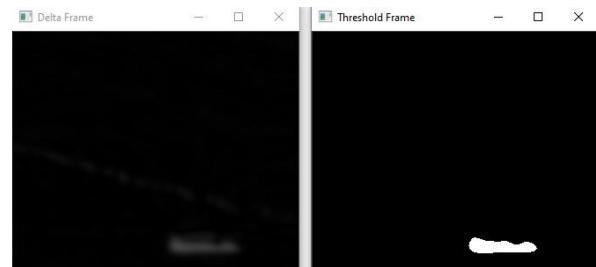

Fig 5.4 Detection of ship

Fig 5.5 Delta and Threshold frames

VII. CONCLUSION

This thesis provides an information about how to implement automated bridge and its advantages. This paper 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, Also the automation made in this project Saves human time and power.

VIII. FUTURESCOPE

The model is build to work only for drawbridge but it can be applied to all types of hydraulic bridges. Also we are using camera to detect the ships coming towards the bridge but if in future for wide range radar can be used and one can make this whole system more efficient by collecting data from all bridges in the city using data analysis technique.

REFERENCES

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