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An intelligent Traffic Control System using ANN

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ABSTRACT

Traffic light is a crucial element in regulating traffic flow by similar waiting and traveling time, fixed traffic light time structures were a poor way of controlling, because number of cars is not compatible with each traffic light, resulting in a system of mismatch.Intelligence traffic grid like clever way of managing traffic light time based on the number of cars in each traffic light, in this project we aim to incorporate an algorithm for managing traffic light time based on artificial intelligent techniques and traffic light picture for vehicles, this algorithm is tested by comparing its results with manual tests.The suggested algorithm in the transport network would control traffic movements and reduce unnecessary travel and waiting time on highways. The results we acquired are substantive and help us better the Traffic Control system we presently use.

Key Words: Traffic, Signal, Controller, Apparatus, Artificial Intelligence

1.INTRODUCTION

Intelligent traffic signal control system has become a wide range of research field due to an increase in vehicle number particularly in big cities, and an increase in accident number. Improving the intelligent traffic signal control system will thereby improve protection, reliability and speed of traffic flow, and reduce average passenger travel and waiting time. Intelligent traffic signal management system incorporates traffic light control systems that monitor the most critical elements on the route, they are systems that manage traffic flow by deciding different waiting, ready and going times.

There are several ways of regulating traffic light time, they are split primarily into two manually controlled sections that involve a professional person to track cars and regulate their speed, thereby consuming man energy and creating unreliable control processes. The other component is automatic controlling, usually divided automatic controlling into sensor-based and image-based processing. Sensor-based system relies on the sensor network to detect cars such as an infrared radar sensor, magnetic loop detectors embedded under lane, this is an expensive operation and involves specific equipment, these sensors do need regular testing to keep their findings reliable.

Photo processing based system relies on images derived from videos that are captured using camera fitted on traffic lights, in which number of cars are measured on each traffic light, then traffic light is monitored according to this number, this approach is the most effective and accurate.

1.1.Motivation and need for the project

Automobile is a great invention for people to extend their territory. Unfortunately, the increasing number of cars causes a series of economic and social problems across the world. In order to generate additional capacity from the existing physical infrastructures, governments and scholars make great effort to develop Intelligent traffic signal control system, a system to gather the information, monitor and schedule the traffic flow, as well as guide and control the vehicles.

There are some disadvantages in the existing system for example, the ultrasonic sensor is very sensitive to the weather. Inductive loop usually impacts the traffic during deployment and as a result of any other construction are vulnerable to breakage.

What's more, all of the above sensors can only detect the vehicles in a fixed spot. They cannot trace the vehicles out of this spot. The main difficulty of the traffic control is usually the forecast of the incoming vehicles.

During changes in the weather conditions, the wireless sensors might not work efficiently which might result in wrong signaling. Hence, it is more efficient to use image processing to detect the traffic density and converts the RGB to grey scale images which is used by Artificial Neural Network, followed by fuzzy logic to control the timer.

2.Body of Paper

2.1.FEASIBILITY STUDY

During this process the project's feasibility is evaluated, and business idea is brought out with a very typical project model and multiple cost estimates. The feasibility evaluation of the proposed approach is to be performed during device review. This is to make sure that the proposed system is not a load to the company. For feasibility analysis, some understanding of the main supplies for the system is essential.

Three main elements of the viability study are:

- Economic Feasibility
- Technical Feasibility
- Social Feasibility

2.1.1.Economic Feasibility:

This research is undertaken to ensure the partnership will have the economic influence the process would have. The amount of fund the firm will inject into the method's investigation and development is limited. The investment needs to be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are generously obtainable. Only the modified goods had to be purchased.

2.1.2.Technical Feasibility:

This research is undertaken to test the technological viability, that is to say the method's technological supplies. Any system built on the available technological assets must not have a high precision. This will lead the high stress on the technological resources which are available. This will direct the putting of excessive tension on the customer. The method created must have a moderate responsibility, as the application of this system needs either nominal or null amendments.

2.1.3.Social Feasibility:

The aspect of study is to ensure the level of approval of the method by the user. This includes the process of training the user to utilize the method proficiently. The user necessity not feel threatened by the method, instead must accept it as a essential. The level of acceptance by the users solely depends on the methods that are employed to instruct the user about the method and to make him recognizable with it. His level of assurance must be raised so that he is also able to make some productive appreciation, which is welcomed, as he is the finishing user of the method.

2.2.SYSTEM ANALYSIS

2.2.1.Existing System

Traffic light control systems are widely used to map and monitor vehicle passage through a variety of road junctions. We strive to explain the smooth movement of cars across transport routes. However, the coordination of multiple traffic light structures at adjacent intersections is a difficult problem given the various parameters involved. Conventional systems can not compensate for dynamic flows that enter junctions.

Disadvantages

- Not effective and/or have some drawbacks such as the high cost of their implementation and maintenance.
- No proper data based on the current status.

2.2.2.Proposed methodology:

The procedure of controlling the traffic light has mainly four parts. To overcome the extreme traffic jams, the modern traffic grid has to be revamped, alleviating mobility issues.

The four main parts are:

2.2.2.1. Acquire and Prepare Image

Firstly, image for road is acquired from an installed camera on tall structures at the traffic light site such that it can capture the overlook of the traffic scene on the road. This camera records video and then images are extracted from the video at a specific time.

After that the image is edited to be suitable for the analysis. For better artificial neural network results, each image is converted from the red-green-blue space to the grey scale so the image will be read in a simpler form.

2.2.2.2. Segmentation

For segmentation part, Sliding Window technique is used, which is an algorithm used for image analysis, it classifies each area of the image by cropping a certain box from the image and after the analysis applied, the box is moved to the next position to apply the analysis on it.

2.2.2.3. Artificial Neural Network

In this part, the output from the segmentation part (the cropped image) is classified to consider if it is a car or not. Firstly, the artificial neural network is tuned using training data. The artificial neural network output depends directly on the training data used for tuning; the training data should be large and covers the most cases that may appear in the image.

2.2.2.4. Fuzzy Logic Controller

The last part is controlling the traffic light depending on the previous parts result (the number of cars in the road). Fuzzy logic is used in this part because it is more reliable and has a biological inspire; the ON/OFF controller has crisp values (0 or 1), but the fuzzy logic controller has various states of truth and it uses reasoning rules for control.

Advantages

- This method is the most efficient and reliable one compared with previously mentioned methods.
- Reduce traveling and waiting time wasted in roads
- This system can control automatically
- Reduce traffic volume and waiting time, minimize overall travel time, optimize cars safety and efficiency, and expand the benefits in health, economic, and environmental sectors

2.2.3.Functional Requirement

- This study develops an automatic algorithm to control traffic light time based on image processing by acquire image for cars on traffic lights and ending with traffic light time
- Proposed algorithm two artificial intelligent techniques used which are artificial neural network and fuzzy logic controller with basic image processing operations, to count number of cars on traffic light and control its time.
  - To overcome the extreme traffic jams, the modern traffic grid has to be revamped, alleviating mobility issues. Server can send the instruction to NODEMCU.

2.2.4.Non-Functional Requirement

- **Usability**

  The client acknowledge be typical nearly the buyer interfaces and committed to ask for ambush pressure in relocating to a unique framework with another condition.

- **Reliability**

The improvements achieved by the Programmer will be evident to the creator of the Project as well as to the developer of the Test.

- **Security**

  Counting bug following the framework must give important security and must secure the entire procedure from slamming.

- **Performance**

  The improvements achieved by the programmer would be evident to the creator of the project as well as to the developer of the test.

- **Portability**

  This is required when the web server, which is facilitating the framework stalls out because of a few issues, which requires their framework to be taken to another framework.

- **Reusability**

  The framework ought to be separated into such modules that it could be utilized as a piece of another framework without requiring a lot of work.3.6 Technologies used.

2.3.Requirement Specification

2.3.1.Hardware Requirements:

- System : Intel i3 2.1 GHZ
- Memory : 4GB.
- Hard Disk : 80 GB.
- Use camera
- NODE MCU
- LED light

2.3.2.Software Requirements:

- Operating System : Windows 7 / 8.
- Language : Python, embedded c
- Tool : python 3.7 , arduino

2.3.3.SOFTWARE DESCRIPTION

2.3.3.1.Python 3.7 ide:

Python is an easy to learn, powerful programming language. It has powerful high-level data structures and an object-oriented programming style that is simple and successful. Along with its interpreted nature, Python 's elegant syntax and dynamic typing make it an excellent language for scripting and fast application creation in many areas on most platforms.

For all major sites on the Python Web site, https:/www.python.org/, the Python interpreter and the comprehensive standard library are freely accessible in source or binary form and can be widely distributed. The same platform also includes updates and links to other free Python third party plugins, programs and tools, as well as additional articles.

The Python interpreter is quickly expanded by adding new functions and data types in C or C++ (or other languages which can be callable from C). Python is also suitable for customisable applications as an auxiliary language.

This guide introduces the reader to the basic Python language and framework principles and functions in an casual manner. It helps to provide a convenient Python interpreter for hands-on learning but all explanations are self-contained such that the tutorial can also be read off-line.

See The Python Standard Library, for a list of basic structures and modules. A more formal description of language is provided by the Python Language Guide. Write Extending and Entering the Python Interpreter and the Python / C API Reference Manual for writing extensions in C or C++. Also, there are many books that cover Python in detail.

FIG 5.1 Python

2.3.3.2.Arduino ide

The Arduino Integrated Development Environment (IDE) is a cross-platform framework written in the programming language Java (for Windows , macOS, Linux); It is used to write and upload programs to boards which are compliant with Arduino, but also other manufacturer development boards with the support of 3rd party cores.

Under GNU General Public License, version 2 the source code for the IDE is released. The Arduino IDE supports the C and C++ languages using special code structuring rules. The Arduino IDE provides a Wiring project software library and provides several typical procedures for input and output.User-written code needs only two simple functions that are compiled and connected to a software stub main) (to launch the sketch and the main program loop into an executable cyclic executive program with the GNU toolchain, which is also included with the IDE delivery. The Arduino IDE uses the avrdude software to translate the executable code into a text file in hexadecimal encoding which a loader software in the firmware of the computer loads into the device.

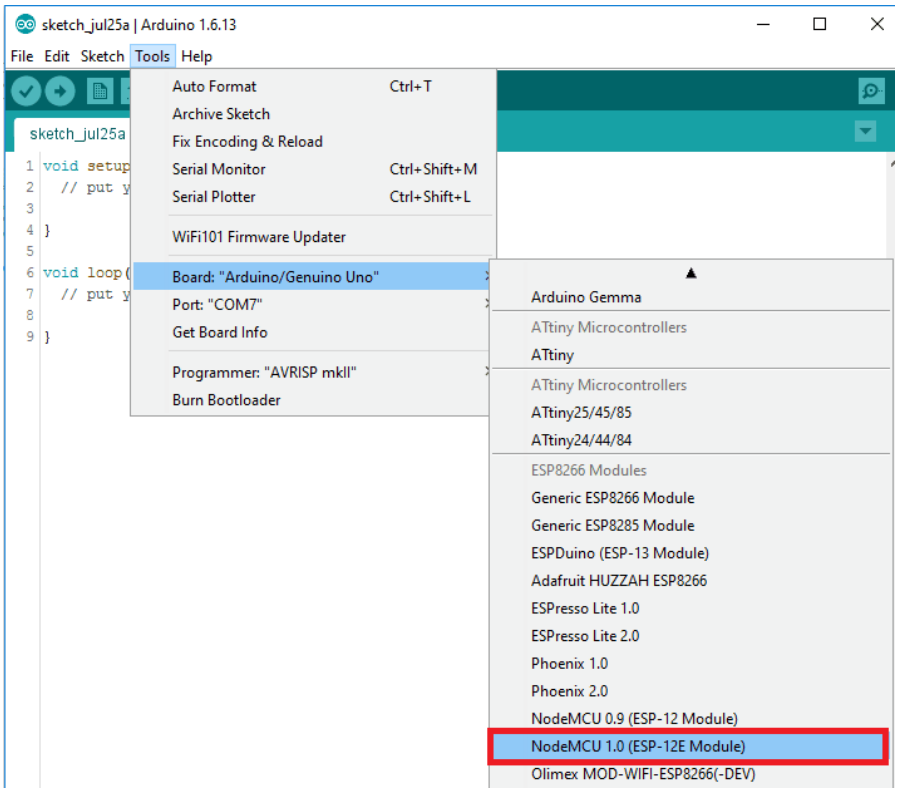


FIG 5.2 Arduino IDE

2.3.4.Hardware Description:

2.3.4.1.NODEMCU:

NodeMCU is a firmware based on open source LUA, built for wifi chip ESP8266. NodeMCU firmware comes with ESP8266 Development Board / Package by testing features with ESP8266 device. Production board NodeMCU.

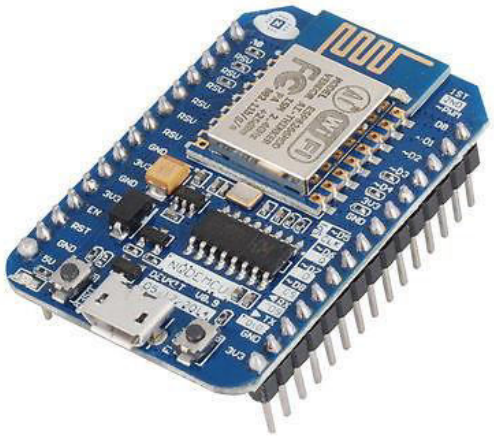


FIG 5.3 NodeMCU Development Board/kit v0.9 (Version1)

Since NodeMCU is an open source framework, edit / modify / build of their hardware design is available.

NodeMCUDev Kit / board consists of wifi compatible chip ESP8266. The ESP8266 is a low-cost, TCP / IP protocol Wi-Fi chip produced by Espressif Systems. For more information on ESP8266, please refer to WiFi module ESP8266.

NodeMCUDev Kit is compatible with Version2 (V2) i.e. Technology Board NodeMCU v1.0 (Version2), which normally comes in black PCB.

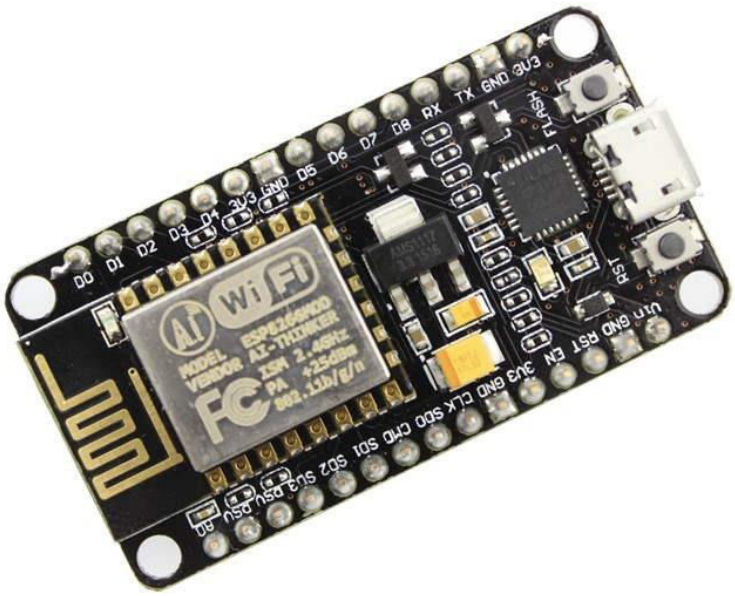


FIG 5.4 NodeMCU Development Board/kit v1.0 (Version2)

For more information about NodeMCU Boards available in market refer NodeMCU Development Boards. NodeMCUDev Kit has **Arduino like** Analog (i.e. A0) and Digital (D0-D8) pins on its board. It supports serial communication protocols i.e. UART, SPI, I2C etc.

Using such serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.

2.3.4.2.LED light:

An LED is a small light which works with relatively little power (it stands for "light emitting diode"). There's one built-in nodemcu board on wireless pin.

LEDs have polarity, so they can only light up while you are correctly orienting the hands. The long leg is usually optimistic, and should be attached to the nodemcu board with a remote button. The short leg goes to GND; on this line, too, the LED

bulb should usually have a flat lip.

FIG 5.5 LED Light

2.3.5.Technologies used

2.3.5.1.PYTHON

Python is an object-oriented programming language created in 1989 by Guido Rossum. Ideally suited for fast prototyping of complex applications. This provides interfaces to other operating system calls and libraries, which can be extended to either C or C++. The Python programming language is used by several major corporations including NASA, Facebook , Twitter, BitTorrent etc.

Python is commonly used in computer science, Artificial Intelligence, Natural Language Processing, Neural Networks and other specialized areas. Python focuses heavily on code readability and this class will teach you the fundamentals of python.

Python language used by IR and HD video

Characteristics of Python

- It provides rich data types and easier to read syntax than any other programming languages
- It is a platform independent scripted language with full access to operating system API's
- Compared to other programming languages, it allows more run-time flexibility
- It includes the basic text manipulation facilities of Perl and Awk
- A module in Python may have one or more classes and free functions
- Libraries in Pythons are cross-platform compatible with Linux, MacIntosh, and Windows

2.3.5.2.Arduino Embedded C

I eventually broke down a few years back, and purchased a microprocessor board from Arduino. This seemed like a healthy, inexpensive way to brush up on my microprocessor expertise, and I might even broaden my horizons a little with all the gadgets available. I've taken the normal road ever since with flashing Lights and galore buzzers. I have used my trusty Ethernet shield to test networked devices.

I have used the Arduino IDE up to now, which is a fine, painless way to get programs running on the computer. This uses a subset of the 'C' language for simple access to several on-board device libraries and features such as timers and I / O ports. Nonetheless, the simplicity of operation comes at the cost of some of the full-scale performance embedded 'C' and hides from the consumer some valuable microprocessor information. For eg, in the loop) (routine, not only are the system functions executed but the routine constantly checks context functions such as the serial port and timers.The analog read) (feature always selects the analog channel before making a conversion which slows down the process significantly.

Of course, there are ways around these things, but by the time you introduce them, the code will continue to look like an embedded 'C' program, and it may be time to bite the bullet and continue programming in C. Another explanation for programming microprocessors in C is that C has become the de-facto standard for the production of microprocessors, and if you switch machines you continue operating in your new setting.

2.4.SYSTEM DESIGN

2.4.1.Introduction

The framework configuration prepare develops general structure building outline. Programming diagram incorporates addressing the item system works in a shape that might be changed into at least one anticipates. The essential demonstrated by the end customer must be placed in a systematical way. Diagram is a creative system; an extraordinary design is the best approach to reasonable structure. The structure "Layout" is portrayed as "The methodology of applying distinctive frameworks and guidelines with the ultimate objective of describing a strategy or a system in sufficient purpose important to permit its physical affirmation". Diverse design segments are taken after to add to the system. The design detail depicts the segments of the system, the sections or segments of the structure and their appearance to end-customers.

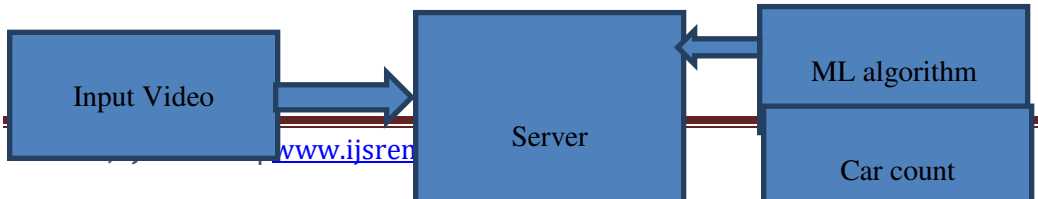
2.4.2.Design Consideration

The explanation behind the plan is to orchestrate the course of action of the issue dictated by the necessities report. This stage is the underlying stage in moving from issue to the game plan space. All things considered, start with what is obliged; diagram takes us to work towards how to satisfy those necessities. The design of the system is perhaps the most essential segment affecting the way of the item and note worthily affects the later stages, particularly testing and upkeep. System diagram delineates all the huge data structure, report game plan, yield and genuine modules in the system and their Specification is picked.

2.4.3.System Architecture

The architectural configuration procedure is concerned with building up a fundamental basic system for a framework. It includes recognizing the real parts of the framework and interchanges between these segments. The initial design technique to identify these subsystems and create a subsystem control and correspondence structure is called construction modeling outline, and the yield of this outline technique is a representation of the structural planning of the component. The architecture proposed for this program is described below. It explains how this program is designed, and how the system operates briefly.

System Architecture



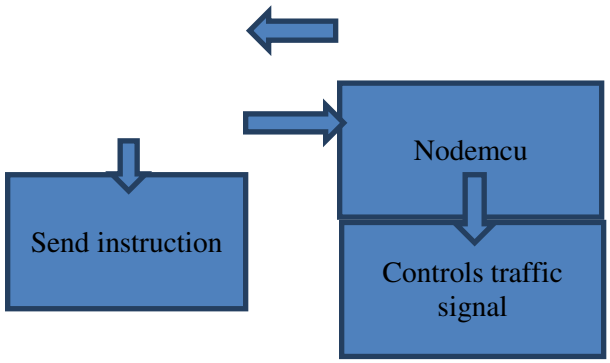


FIG 6.1 System Architechture

2.4.4.Flow Chart:

A flowchart is a kind of diagram describing a process or workflow. You may also describe a flowchart as a diagrammatic representation of an algorithm, a step-by - step approach to resolving a problem.

The flowchart displays the phases as different types of boxes, and their order by linking the boxes to arrows. This diagrammatic representation displays a model of solution to a given problem. Flowcharts are used in different ways for the analysis, architecture, reporting or management of a method or system..

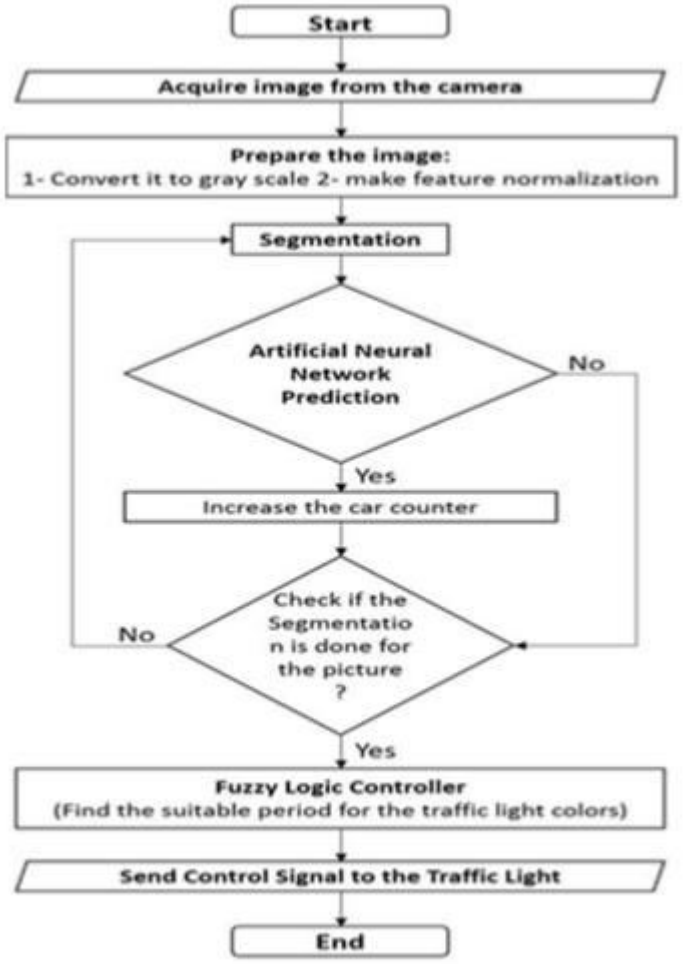


FIG 6.2 System Flowchart

2.4.5.Data Flow Diagrams:

The DFD is clear graphical formalism that can be used to address a structure the extent that the data to the system, diverse get ready did on this data and the yield data made by the structure. A DFD demonstrate utilizes an incredibly foreordained number of primitive pictures to address the limits performed by a system and the data stream among the limits.

The standard inspiration driving why the DFD strategy is so celebrated is probably in light of the way that DFD is an uncommonly essential formalism-It is anything but difficult to fathom and use. Starting with the course of action of strange state works that a system plays out, a DFD show dynamically addresses diverse sub limits. Really, any different leveled model is anything but difficult to get it.

Human identification is to such an extent that it can see without such a bit of an extension any complex form of a structure in the light of the way that unmistakable motives of interest of a structure are little by little inserted through the numerous demands in a particular graduated view, beginning with a to a great degree simple and extraordinary type of design. An overview of information streams (DFD) is a graphical description of the "path" of data through an information system. DFDs

should be used for displaying data that is taken care of in the same way.

2.4.6.DFD Components:

DFD can use the following set of components to describe the source, destination, storage and data flow -

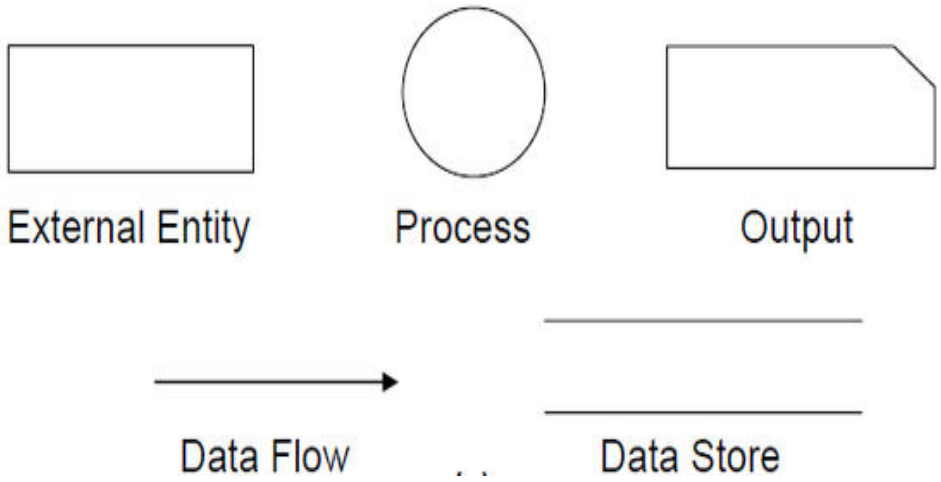


Fig 6.3 DFD Components

Fig 6.3 DFD Components

Entities - Entities are data point and the destination. Entities with their respective names are represented in rectangles.

Process - Circle or Round edged rectangles represent events and actions taken on the results.

Data Storage - There are two types of data storage-either as a rectangle with all smaller sides omitted, or as an open-sided rectangle with just one side lacking.

Data Flow - Data movement is represented by pointy arrows. Data flow is seen as its origins from the arrow base towards the arrow head as its endpoint.

Data Flow Diagram

Level 0

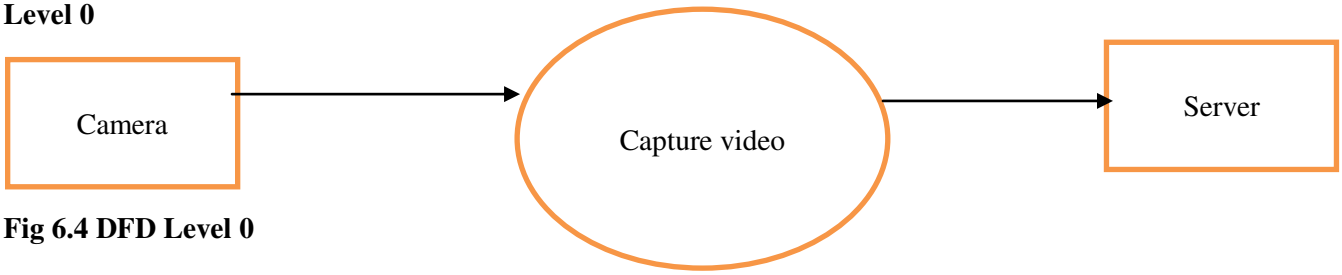
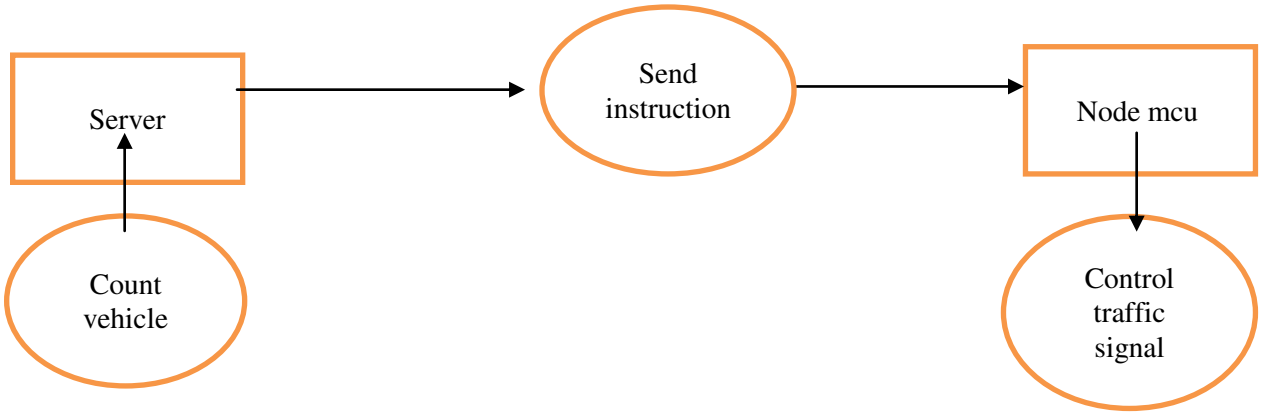


Fig 6.4 DFD Level 0

Level 1



6.5 DFD Level 1

2.4.7.Use case diagram:

A utilization case outline is a sort of behavioral diagram produced using a Use-case examination. Its question is to show a graphical outline of the handiness gave by a structure with respect to entertainers, their destinations (addressed as use cases), and any conditions between those use cases. Utilize case diagram gives us the information about how that customers and use cases are associated with the system. Utilize cases are utilized in the midst of requirements elicitation and examination to address the convenience of the structure. Utilize cases focus on the direct of the system from an outside point of view.

A utilization case delineates a limit gave by structure that yields an undeniable outcome for an entertainer. A performing craftsman depicts any component that teams up with the framework. The entertainers are outside the point of confinement of the structure, while the utilization cases are inside the utmost of the system. On-screen characters are addressed with stick figures, utilize cases with ovals, and the breaking point of the structure with a holder encasing the utilization cases.

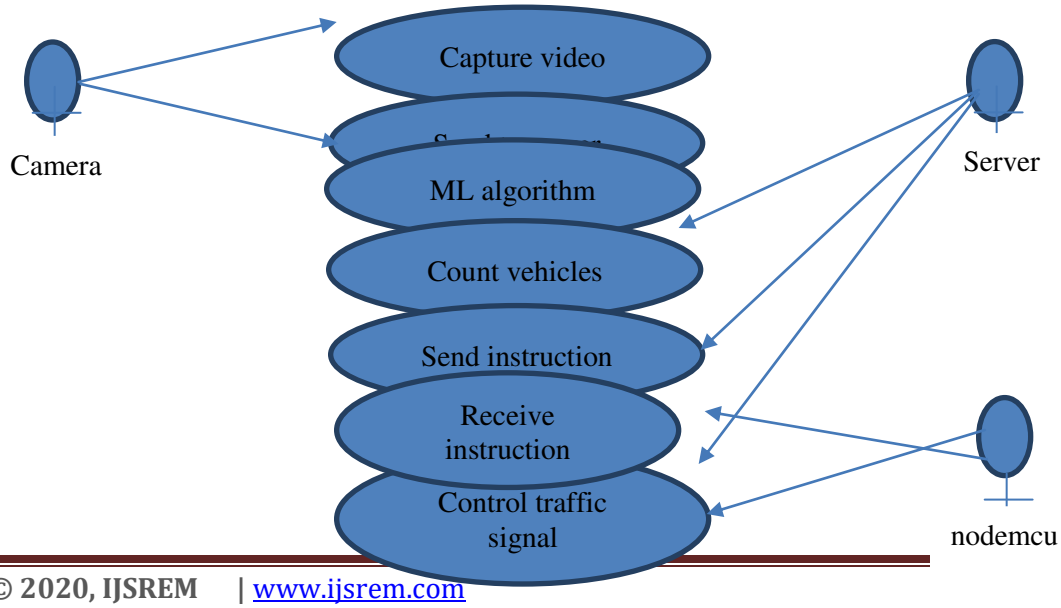


FIG 6.6 Use Case Diagram

2.4.8.Sequence diagram:

A succession chart is an incorporated Modeling Language is a kind of correspondence outline that shows systems work with each other and in what ask. Grouping charts are as a less than dependable rule called event take after outlines, event circumstances, and timing graph. Arrangement charts are used to formalize the lead of the structure and to picture the correspondence among articles. They are significant for perceiving additional inquiries that participates in the usage cases. An arrangement chart addresses the affiliations that occur among these articles.

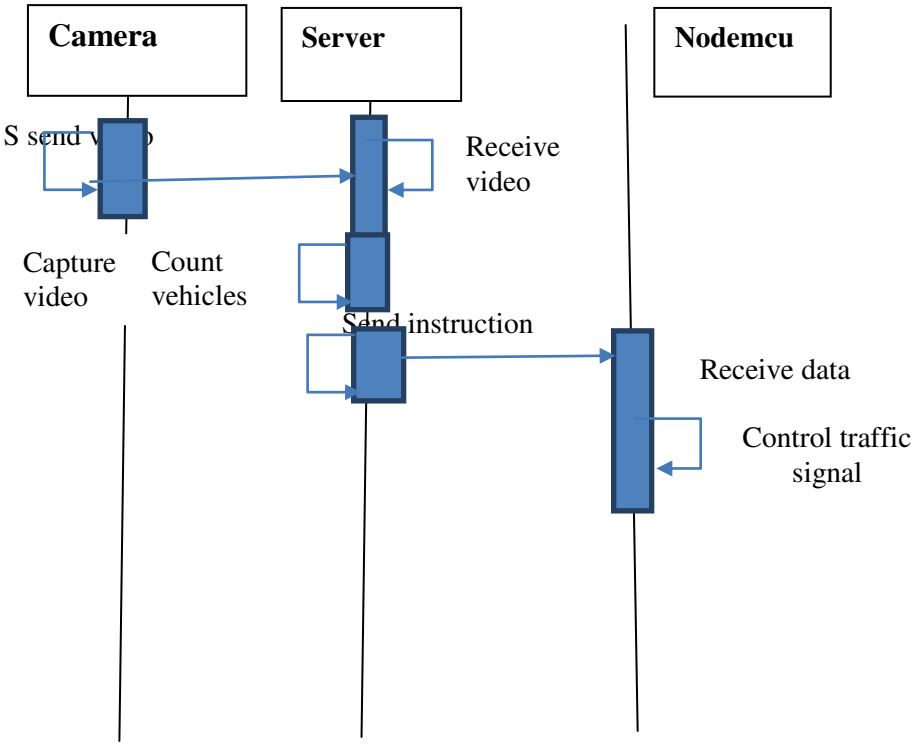


FIG 6.7 Sequence Diagram

2.5.SYSTEM TESTING

2.5.1.Introduction

Testing of any product comprise of giving the product an arrangement of test information and watching if the product carries on not surprisingly, if the product neglects to carry on obviously ,then the conditions under which of disappointment happens are noted for investigating and amendment. At last the framework in general is tried to guarantee that blunder in past countenances are revealed and the venture acts as determined.

Basics of software testing:

2.5.2. Black Box testing

Black box checking is done to find out what happens

- ✓ Incorrect or missing functions
- ✓ Interface errors
- ✓ Errors on external database access
- ✓ Performance error
- ✓ Initialization and termination error

2.5.3. White Box Testing

This makes for the tests

- ✓ Test whether all individual node paths were exercised at least once
- ✓ Practice on their fake sides all rational judgments
- ✓ Execute all loops within their limits and boundaries
- ✓ Using the internal data system to guarantee its authenticity
- ✓ Ensure that all validity checks and validity lookups have been given to verify the entry of data.

2.5.4.Types of Testing

Following are the different types of testing

- ➢ Unit Testing
- ➢ Integration Testing
- ➢ System Testing
- ➢ Performance Testing
- ➢ Validation Testing
- ➢ Acceptance Testing

Let us consider each testing and discuss on it in detail. Firstly we move to the first testing and give its detail description.

2.5.4.1.Unit Testing

Singular part are tried to guarantee that they work accurately. Every part is tried freely, without other framework segment. This framework was tried with the arrangement of legitimate test information for every module and the outcomes were checked with the normal yield. Unit testing centers around confirmation exertion on the littlest unit of the product outline module. This is otherwise called MODULE TESTING. This testing is done amid stages, every module is observed to work agreeable as respects to the normal yield from the module.

2.5.4.2.Integration Testing

Mix testing is another part of testing that is for the most part done keeping in mind the end goal to reveal mistakes related with stream of information crosswise over interfaces. The unit-tried modules are assembled together and tried in little section, which make it less demanding to seclude and revise mistakes. This approach is proceeded with unit I have coordinated all modules to frame the framework all in all.

2.5.4.3.System Testing

System learning is simply a continuum of various experiments whose central function is to thoroughly apply the PC-based system. System verification guarantees that the whole programming design that has been implemented satisfies the prerequisites. This checks a template to ensure outcomes which are proven and unsurprising. The configuration structured system mix checking is a case of application testing. Framework research focuses on the definition and streaming of systems, stressing predriver systems and concentrating on integration.

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2.5.4.4.Performance Testing

The execution testing guarantee that the yield being delivered inside as far as possible and time taken for the framework aggregating, offering reaction to the clients and demand being send to the framework so as to recover the outcomes.

2.5.4.5.Validation Testing

The approval testing can be characterized from multiple points of view, however a straightforward definition is that. Approval succeeds when the product capacities in a way that can be sensibly expected by the end client.

2.5.4.6.Acceptance Testing

This is the last phase of testing procedure before the framework is acknowledged for operational utilize. The framework is tried inside the information provided from the framework procurer instead of recreated information.

CONCLUSION

It has been found that the process used in this study is very useful and can improve the traffic light job with less cost than the other methods discussed before. For the image analysis, it has been found that the image should be modified before analysis are applied on it; like converting it to the grayscale and normalizing its elements.

It has been also found that the Sliding Window technique is very useful for segmentation and any other analysis on the images. It has been improved such that its size is changed during the implementation so it can indicate any car regardless its

size. The artificial neural network has an accepted output with a maximum error of 4% and it can be reduced by aligning the camera correctly with the road. The error can also be reduced if the training data is increased with a new data that covers more cases. It has been found that the error does not depend on the number of cars in the road.

For the fuzzy logic controller, it has been found that it is reliable and has a biological inspire. So, it is preferred to be used with systems that have analog inputs and outputs because it has reasoning rules.

ACKNOWLEDGEMENT

The success and final outcome of this project work required the guidance and the assistance of many people. We would like to add a few words of appreciation to the people who have been a part of this right from its inspection. Without their support, patience and guidance, this task would not have been completed. It is to them we owe our greatestgratitude.

We take this opportunity to express our deep regards to **Dr. C.P.S PRAKASH**, Principal, DayanandaSagar College of Engineering for providing an opportunity to do this project as a part of our curriculum in partial fulfillment of the degree course.

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