FINAL PROJECT REPORT

ON

"SMART TRAFFIC CONTROLLING SYSTEM"

Submitted for the requirement of

Project course

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE & ENGINEERING

Submitted to :

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APRIL-MAY 2020

CERTIFICATE

This is to certify that the work embodied in this Project Report entitled “Smart trafficcontrolling system ” being submitted by “ **Ujjwal, Gourav, Rahul, Monika** ” - UID “**17BCS2953, 17BCS2961, 17BCS2958, 17BCS2962** ”, 5^{th} Semester for partial fulfillment of the requirement for the degree of “ Bachelor of Engineering in Computer Science & Engineering ” discipline in “ Chandigarh University ” during the academic session July-Dec 2019 is a record of bonafide piece of work, carried out by student under my supervision and guidance in the“ Department of Computer Science & Engineering ”, Chandigarh University.

APPROVED & GUIDED BY:

Aarti Mahajan

DECLARATION

We **Ujjwal kumar,Gourav kumar, Rahul ,Monika,** student of **Bachelor of Engineering** in **Computer Science & Engineering, 5th Semester** , **session: July – Dec 2019, Chandigarh University,** hereby declare that the work presented in this Project Report entitled **"smart traffic controlling system "** is the outcome of my own work, is bona fide and correct to the best of my knowledge and this work has been carried out taking care of Engineering Ethics. The work presented does not infringe any patented work and has not been submitted to any other university or anywhere else for the award of any degree or any professional diploma.

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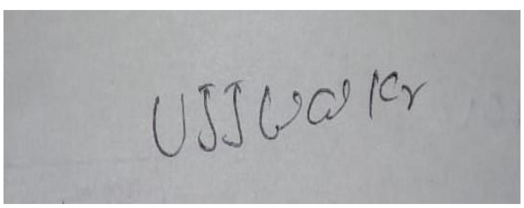

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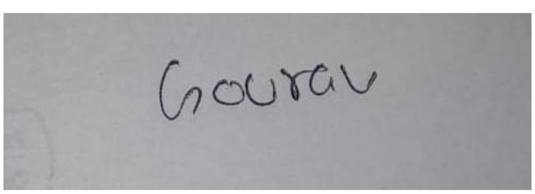

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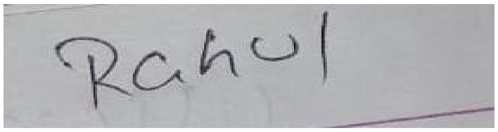

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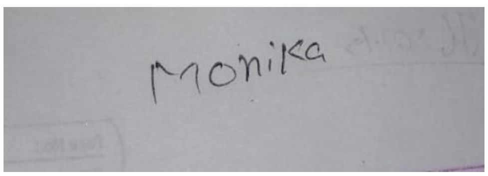

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ABSTRACT

Traffic light control systems are widely used to monitor and control the flow of automobiles through the junction of many roads. They aim to realize smooth motion of cars in the transportation routes. However, the synchronization of multiple traffic light systems at adjacent intersections is a complicated problem given the various parameters involved. Conventional systems do not handle variable flows approaching the junctions. In addition, the mutual interference between adjacent traffic light systems, the disparity of cars flow with time, the accidents, the passage of emergency vehicles, and the pedestrian crossing are not implemented in the existing traffic system. This leads to traffic jam and congestion. We propose a system based on PIC microcontroller that evaluates the traffic density using IR sensors and accomplishes dynamic timing slots with different levels. Moreover, a portable controller device is designed to solve the problem of emergency vehicles stuck in the overcrowded roads. Keywords—Traffic light system; microcontroller; XBee wireless communication; IR sensor; traffic density. The design of intelligent traffic control system is an active research topic. Researchers around the world are inventing newer approaches and innovative systems to solve this stressful problem. Models based on mathematical equations are applied to estimate the car waiting time at a junction, the number of cars in the waiting queue, the extension of the waiting cars along the lane, the optimal timing slots for green, yellow, and red lights that best fit the real and veritable situation and the efficient combination of routing. In fact, the mutual dependencies between nearby intersections lead to a complicated formulation with cumbersome parameters. These parameters are accidental, hazardous, dependent, and the worse point is the variance of these parameters with time.

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INTRODUCTION:

Traffic lights, developed since 1912, are signaling devices that are conceived to control the traffic flows at road intersections, pedestrian crossings, rail trains, and other locations. Traffic lights consist of three universal colored lights: the green light allows traffic to proceed in the indicated direction, the yellow light warns vehicles to prepare for short stop, and the red signal prohibits any traffic from proceeding . Nowadays, many countries suffer from the traffic congestion problems that affect the transportation system in cities and cause serious dilemma. In spite of replacing traffic officers and flagmen by automatic traffic systems, the optimization of the heavy traffic jam is still a major issue to be faced, especially with multiple junction nodes. The rapid increase of the number of automobiles and the constantly rising number of road users are not accompanied with promoted infrastructures with sufficient resources. Partial solutions were offered by constructing new roads, implementing flyovers and bypass roads, creating rings, and performing roads rehabilitation. However, the traffic problem is very complicated due to the involvement of diverse parameters. First, the traffic flow depends on the time of the day where the traffic peak hours are generally in the morning and in the afternoon; on the days of the week where weekends reveal minimum load while Mondays and Fridays generally show dense traffic oriented from cities to their outskirts and in reverse direction respectively; and time of the year as holidays and summer. Secondly, the current traffic light system is implemented with hard coded delays where the lights transition time slots are fixed regularly and do not depend on real time traffic flow. The third point is concerned with the state of one light at an intersection that influences the flow of traffic at adjacent intersections. Also, the conventional traffic system does not consider the case of accidents, roadworks, and breakdown cars that worsen traffic congestion. In addition, a crucial issue is related to the smooth motion through intersections of emergency vehicles of higher priorities such as ambulances, rescue vehicles, fire brigade, police, and VIP persons that could get stuck in the crowd. Finally, the pedestrians that cross the lanes also alter the traffic system. The conventional traffic system needs to be upgraded to solve the severe traffic congestion, alleviate transportation troubles, 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. This paper proposes a simple, low-cost, and real time smart traffic light control system that aims to overcome many defects and improve the traffic management. The system is based on PIC microcontroller that controls the various operations, monitors the traffic volume and density flow via infrared sensors (IR), and changes the lighting transition slots accordingly. Moreover, a handheld portable device communicates wirelessly with the traffic master controller by means of XBee transceivers in order to run the appropriate subroutines and allow the smooth displacement of emergency vehicles through the intersection.

mers then the vehicle will waste precious time at most intersections. The expansion of road infrastructure is not ultimate solution to the traffic congestion. It requires some smart mechanism that deals with the problems in the present traffic controlling system. The proposed system also provides the map feature, which shows the traffic situation of requested traffic signal. The problems in the conventional traffic control system are overcome with the following features of proposed system: A. Dynamic time interval: The present traffic light control system provides fixed time interval for red and green light. This causes unnecessary waiting time. As the design of proposed system provides dynamic traffic light intersection that will minimize the waiting time of vehicles and also manage the traffic load at the intersection adaptively. This maximizes average number of vehicles passing through each intersection.

2. <u>BACKGROUND:</u>

This section includes the general background information on the smart traffic controlling system. This section also covers our goals and specifications for the project undertaken.

In this section, the various solutions to the traffic congestion problems suggested in the literature are presented as below: A. Expert System: Expert System based Traffic Light Controller described by Findler and Stapp (1992) [5]. An expert system uses the set of rules to decide the next action. In traffic Light control such an action can change some of control parameters that means the totally new system implementation required. B. Fuzzy Logic: Fuzzy Logic Traffic Light Controller described by Tan (1995). The fuzzy logic controller determines the time that the traffic light should stay in a certain state, before switching to the next state. This system has the disadvantage of the controller since it depends on the preset quantification values for fuzzy variables. C. Reinforcement Learning: Reinforcement learning based Traffic Light Controller described by Thorpe[4] (1997). In this system, neural network is used for the traffic-light based value function which predicts the waiting time for all cars standing at the junction. This means that traffic light controller have to deal with a huge number of states, where learning time and variance may be quite large. D. Prediction based optimization: Prediction based optimization based Traffic Light Controller described by Tavladakis and Voulgaris[3] (1999). In this system, Measurements taken during the current cycle are used to test several possible settings for the next cycle. Since it only uses the data of one cycle, it could not handle strong fluctuations in traffic flow well. Hence it gives poor performance. E. Using Magneto-Resistive Sensors: The author Cai Bai-gen[2] (2009) design a vehicle detection system based on magneto-resistive sensor is composed by wireless traffic information collection nodes which are set on two sides of road to detect vehicle signal . The magneto-resistive sensor is costly and maintenance cost of the system will be more if the system fails. This system has lacks of emergence measures. • The proposed operation of Traffic Light Controller uses the Infrared sensors to detect vehicle. The presence or absence of vehicle is sensed by sensor assembly mounted on each road. This act as input to Traffic Light Control Unit. • The basic operation of Smart Traffic System Unit can be realized by using embedded system which has advantage of simplicity, user friendly, easy programmable. • The smart system must inform the person about the happenings and should also inform alternate route to avoid loss of time. In this project, we are implementing to inform the car drivers about congested and alternate routes for rapid transit. Conditions on roads are communicated to car drivers on their personal GSM mobile sets, which will help them to select proper route. • Proposed STC system is able to handle the problem of emergency vehicle by giving priority to it. That is, when emergency vehicle is passing by the route then other vehicles will get red signal and emergency vehicle can easily pass by the route

2.1 Project Design:

The designed smart traffic light control system corresponds to a junction of 4 mono directional roads in the form of "+" . We aim in the first place to investigate the technologies of the existing systems and seek the most appropriate employed devices. We try also to test the proposed integrated design as architecture, hardware, and software.

2.1.1 Modules:

Open cv: OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. In simple language it is library used for Image Processing. It is mainly used to do all the operation related to Images.

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. In simple language it is library used for Image Processing. It is mainly used to do all the operation related to Image.

OpenCV has a modular structure, which means that the package includes several shared or static libraries. The following modules are available:

- **Core functionality** (**core**) - a compact module defining basic data structures, including the dense multi-dimensional array Mat and basic functions used by all other modules.
- **Image Processing** (**imgproc**) - an image processing module that includes linear and non-linear image filtering, geometrical image transformations (resize, affine and perspective warping, generic table-based remapping), color space conversion, histograms, and so on.
- **Video Analysis** (**video**) - a video analysis module that includes motion estimation, background subtraction, and object tracking algorithms.
- **Camera Calibration and 3D Reconstruction** (**calib3d**) - basic multiple-view geometry algorithms, single and stereo camera calibration, object pose estimation, stereo correspondence algorithms, and elements of 3D reconstruction.
- **2D Features Framework** (**features2d**) - salient feature detectors, descriptors, and descriptor matchers.
- **Object Detection** (**objdetect**) - detection of objects and instances of the predefined classes (for example, faces, eyes, mugs, people, cars, and so on).
- **High-level GUI** (**highgui**) - an easy-to-use interface to simple UI capabilities.

2.1.2 Advantages of a Modules:

A program module is capable of being re-used in a program which minimizes the development of redundant codes. It is also more convenient to reuse a module than to write a program from start. It also requires very little code to be written. Having a program broken into smaller sub-programs allows for easier management.

2.2 Specifications and Goals:

Since, these systems affect the daily traffic population, the system should be secure enough and shouldn’t allow intruders to make changes or install bugs in it. Only System administrator should be authorized to access, modify, halt and carry out any other functions.The main goal is to reduce the traffic in a city.

3. SYSTEM DESGIN:

This section explains in details how the project was approached. All hardware and software components that will be used will be explained in this section of the report. Problems encountered and solutions to these problems will not be mentioned in this section of the report.

3.1 Project Overview:

In our proposed System, four cameras at one junction of a four-way road will be installed. Individual camera will monitor one lane. Cameras will continuously collect the recordings. A computer system which is centralized for the all four cameras will be connected with these cameras. By using Visual C++ software and Intel's OpenCV video stream processing system, automatic vehicle detection and vehicle counting can be done. The analysis on the recordings (i.e. Image Processing) should be parallel and synchronized for the effective decision making. The processed output which is number of vehicles is feed to the system which would be allocating resources to each lane using proposed adaptive algorithm. Generally, the traffic system is controlled by three signal lights- green, red and yellow . The reason why traffic congestion (commonly termed as traffic jams) occurs is increasing number of vehicles and poor management of traffic algorithms. There is no fixed infrastructure for every junction, street and road which leads to loopholes in construction of fixed timing algorithms. Previously, human administrated or automated offline softwares were used for computation of time slots given to each signal at traffic signals. But these timings used to fail at specific times of the day or particular days(festivals etc.), which led to the development of self-automated online systems which continuously sense the environment and compute the timings to be given to traffic signal at a particular instant. Our objective here is to construct such dynamic system algorithm which alleviates the traffic at traffic junctions leading to smooth movement of traffic flow.

3.1.1 The Research Stage

The research stage was a critical stage that provided our team with the knowledge necessary to complete the other stages of our project. This stage was an ongoing process that our team had to return to many times during the development process to gain the knowledge needed to continue on with the project. Our research encompassed a wide range of sources, which included studies done at different universities and hobby enthusiast sources. Our research included the different type of the modules and sensors which is used in this project .This project contain use of the aurdino uno and cameras.

On Tuesday the 30 of July 2019 the first experiment of a traffic signal regulated by 100% "connected" vehicles was carried on at University of Calabria (Unical) with the help of common commercial smart phones by a team of researchers working for Unical and the innovative Start Up SOMO. Meanwhile, in the United Kingdom, lights that change to red when sensing that an approaching motorist is traveling too fast are being trialled in Swindon[7] to see if they are more effective at reducing the number of accidents on the road than the speed cameras that preceded them and which were removed following a council decision in 2008. These lights are more focused on encouraging motorists to obey the law but if they prove to be a success then they could pave the way for more sophisticated systems to be introduced in the UK.

3.1.2 Building & Interfacing Stage

The smart light traffic control system is composed of two separate devices: the traffic master controller and the handheld portable controller. The traffic master controller is mounted with the traffic lights at the roads intersection and is responsible for the lighting transition and their timing slots.

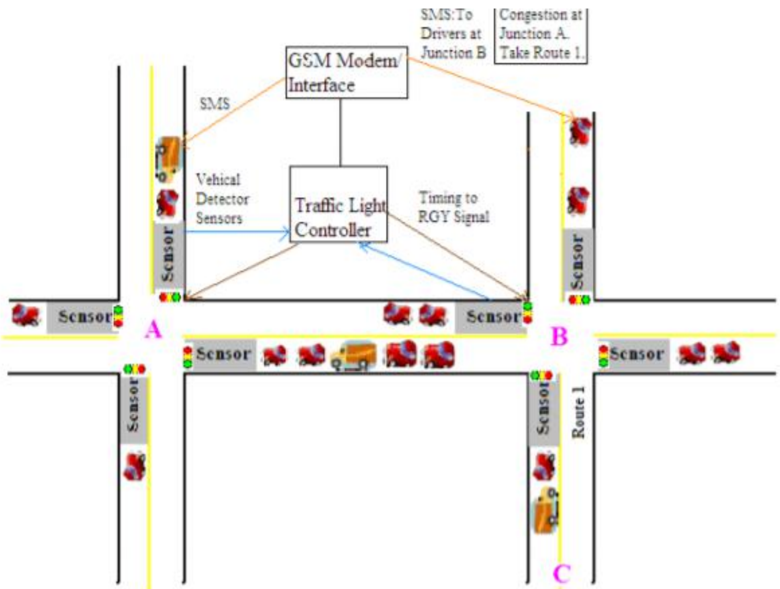


Fig.2. Basic concept of Smart Traffic Light Controller

3.1.3 Existing System

The traffic lights used in India are basically pre-timed wherein the time of each lane to have a green signal is fixed. In a four lane traffic signal one lane is given a green signal at a time. Thus, the traffic light allows the vehicles of all lanes to pass in a sequence. So, the traffic can advance in either straight direction or turn by 90 degrees as shown in Fig.1. So even if the traffic density in a particular lane is the least, it has to wait unnecessarily for a long time and when it gets the green signal it unnecessarily makes other lanes wait for even longer durations.

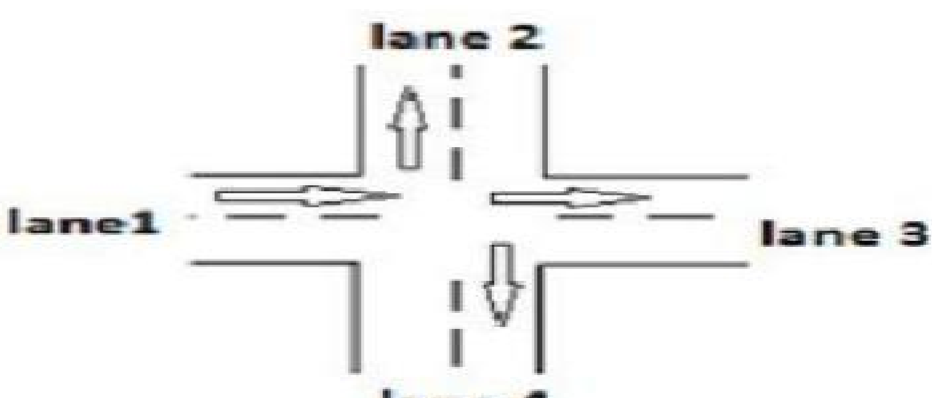


Fig.1 Lane diagram

3.1.4 The Programming Stage

Machine learning: As far as using Artificial Intelligence in open space, such as roads, is concerned, it can be considered to be a possibility to install AI enabled traffic management system as part of the infrastructure before launching the self-driving vehicles. An AI enabled traffic management system can provide greater leeway to the self-driving vehicles as they can then be directed and controlled more by the external environment.

Recently, the Delhi Traffic Police has obtained permission from the Ministry of Home Affairs to set up an intelligence traffic management system (ITMS) which will work on a radar-based monitoring with the help of Artificial Intelligence. One of the key tools in the system will be automated traffic signals. It will help the Delhi Traffic Police to analyse the traffic pattern, volume, number of vehicles and collect them on a cloud which will be further used to manage the traffic.

Intelligent transport systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitor applications, such as security CCTV systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge de-icing (US deicing) systems; and the like. Additionally, predictive techniques are being developed to allow advanced modelling and comparison with historical baseline data. Some of these technologies are described in the following sections.

Numpy: NumPy targets the CPython reference implementation of Python, which is a non-optimizing bytecode interpreter. Mathematical algorithms written for this version of Python often run much slower than compiled equivalents. NumPy addresses the slowness problem partly by providing multidimensional arrays and functions and operators that operate efficiently on arrays, requiring rewriting some code, mostly inner loops using NumPy.

Using NumPy in Python gives functionality comparable to MATLAB since they are both interpreted, and they both allow the user to write fast programs as long as most operations work on arrays or matrices instead of scalars. In comparison, MATLAB boasts a large number of additional toolboxes, notably Simulink, whereas NumPy is intrinsically integrated with Python, a more modern and complete programming language. Moreover, complementary Python packages are available; SciPy is a library that adds more MATLAB-like functionality and Matplotlib is a plotting package that provides MATLAB-like plotting functionality. Internally, both MATLAB and NumPy rely on BLAS and LAPACK for efficient linear algebra computations.

Python bindings of the widely used computer vision library OpenCV utilize NumPy arrays to store and operate on data. Since images with multiple channels are simply represented as three-dimensional arrays, indexing, slicing or masking with other arrays are very efficient ways to access specific pixels of an image. The NumPy array as universal data structure in OpenCV for images, extracted feature points, filter kernels and many more vastly simplifies the programming workflow and debugging. NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

It is the fundamental package for scientific computing with Python. It contains various features including these important ones.Array in Numpy is a table of elements (usually numbers), all of the same type, indexed by a tuple of positive integers. In Numpy, number of dimensions of the array is called rank of the array.A tuple of integers giving the size of the array along each dimension is known as shape of the array. An array class in Numpy is called as **ndarray**. Elements in Numpy arrays are accessed by using square brackets and can be initialized by using nested Python Lists.

TIME: This module provides various time-related functions. For related functionality, see also the datetime and calendar modules.Although this module is always available, not all functions are available on all platforms. Most of the functions defined in this module call platform C library functions with the same name. It may sometimes be helpful to consult the platform documentation, because the semantics of these functions varies among platforms.

An explanation of some terminology and conventions is in order.

- The *epoch* is the point where the time starts, and is platform dependent. For Unix, the epoch is January 1, 1970, 00:00:00 (UTC). To find out what the epoch is on a given platform, look at time.gmtime(0).
- The term seconds since the epoch refers to the total number of elapsed seconds since the epoch, typically excluding leap seconds. Leap seconds are excluded from this total on all POSIX-compliant platforms.
- The functions in this module may not handle dates and times before the epoch or far in the future. The cut-off point in the future is determined by the C library; for 32-bit systems, it is typically in 2038.
- Function strptime() can parse 2-digit years when given %y format code. When 2-digit years are parsed, they are converted according to the POSIX and ISO C standards: values 69–99 are mapped to 1969–1999, and values 0–68 are mapped to 2000–2068.

- UTC is Coordinated Universal Time (formerly known as Greenwich Mean Time, or GMT). The acronym UTC is not a mistake but a compromise between English and French.

- DST is Daylight Saving Time, an adjustment of the timezone by (usually) one hour during part of the year. DST rules are magic (determined by local law) and can change from year to year. The C library has a table containing the local rules (often it is read from a system file for flexibility) and is the only source of True Wisdom in this respect.

- The precision of the various real-time functions may be less than suggested by the units in which their value or argument is expressed. E.g. on most Unix systems, the clock “ticks” only 50 or 100 times a second.

- On the other hand, the precision of time() and sleep() is better than their Unix equivalents: times are expressed as floating point numbers, time() returns the most accurate time available (using Unix gettimeofday() where available), and sleep() will accept a time with a nonzero fraction (Unix select() is used to implement this, where available).

- The time value as returned by gmtime(), localtime(), and strptime(), and accepted by asctime(), mktime() and strftime(), is a sequence of 9 integers. The return values of gmtime(), localtime(), and strptime() also offer attribute names for individual fields.

  See struct_time for a description of these objects.

  Changed in version 3.3: The struct_time type was extended to provide the tm_gmtoff and tm_zone attributes when platform supports corresponding struct tm members.

  Changed in version 3.6: The struct_time attributes tm_gmtoff and tm_zone are now available on all platforms.

- Use the following functions to convert between time representations:

From	**To**	**Use**
seconds since the epoch	struct_time in UTC	gmtime()
seconds since the epoch	struct_time in local time	localtime()
struct_time in UTC	seconds since the epoch	calendar.timegm()
struct_time in local time	seconds since the epoch	mktime()

3.2 Physical Components:

This subsection describes all the physical components of our project and how they work. As well as the reasoning for choosing the GPS module, SD card, battery, cameras transmitter and receiver, Raspberry pi, wireless Adapter, connecting wire, traffic signals etc.

3.2.1 Traffic signals

Smart traffic lights or Intelligent traffic lights are a vehicle traffic control system that combines traditional traffic lights with an array of sensors and artificial intelligence to intelligently route vehicle and pedestrian traffic. They can form part of a bigger intelligent transport system. A technology for smart traffic signals has been developed at Carnegie Mellon University and is being used in a pilot project in Pittsburgh in an effort to reduce vehicle emissions in the city. Unlike other dynamic control signals that adjust the timing and phasing of lights according to limits that are set in controller programming, this system combines existing technology with artificial intelligence.The signals communicate with each other and adapt to changing traffic conditions to reduce the amount of time that cars spend idling. Using fiber optic video receivers similar to those already employed in dynamic control systems, the new technology monitors vehicle numbers and makes changes in real time to avoid congestion wherever possible. Initial results from the pilot study are encouraging: the amount of time that motorists spent idling at lights was reduced by 40% and travel times across the city were reduced by 25%.

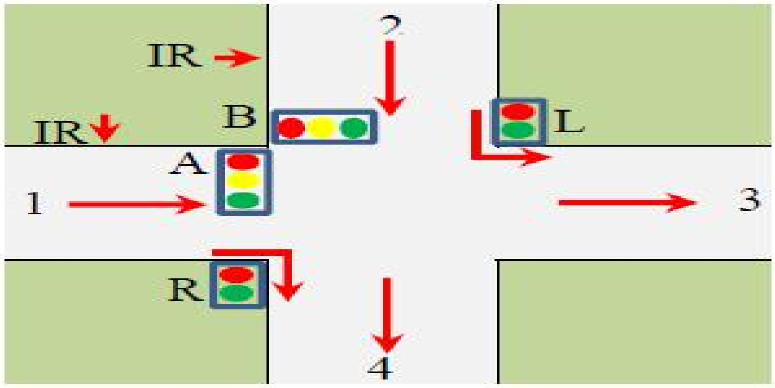
Companies involved in developing smart traffic management systems include BMW and Siemens,[3] who unveiled their system of networked lights in 2010. This system works with the anti-idling technology that many cars are equipped with, to warn them of impending light changes. This should help cars that feature anti-idling systems to use them more intelligently, and the information that networks receive from the cars should help them to adjust light cycling times to make them more efficient.

A new patent appearing March 1st, 2016 by John F. Hart Jr. is for a "Smart" traffic control system that "sees" traffic approaching the intersections and reacts according to what is needed to keep the flow of vehicles at the most efficient rate. By anticipating the needs of the approaching vehicles, as opposed to reacting to them after they arrive and stop, this system has the potential to save motorist time while cutting down harmful emissions.Romanian and US research teams believe that the time spent by motorists waiting for lights to change could be reduced by over 28% with the introduction of smart traffic lights and that CO_2 emissions could be cut by as much as 6.5%.

A major use of Smart traffic lights could be as part of public transport systems. The signals can be set up to sense the approach of buses or trams and change the signals in their favour, thus improving the speed and efficiency of sustainable transport modes.The main stumbling block to the widespread introduction of such systems is the fact that most vehicles on the road are unable to communicate with the computer systems that town and city authorities use to control traffic lights. However, the trial in Harris County, Texas, referred to above, uses a simple system based on signals received from drivers' cell phones and it has found that even if only a few drivers have their phone switched on, the system is still able to produce reliable data on traffic density. This means that the adoption of smart traffic lights around the world could be started as soon as a reasonable minority of vehicles were fitted with the technology to communicate with the computers that control the signals rather than having to wait until the majority of cars had such technology.

Meanwhile, in the United Kingdom, lights that change to red when sensing that an approaching motorist is traveling too fast are being trialled in Swindon[7] to see if they are more effective at reducing the number of accidents on the road than the speed cameras that preceded them and which were removed following a council decision in 2008. These lights are more focused on encouraging motorists to obey the law but if they prove to be a success then they could pave the way for more sophisticated systems to be introduced in the UK.

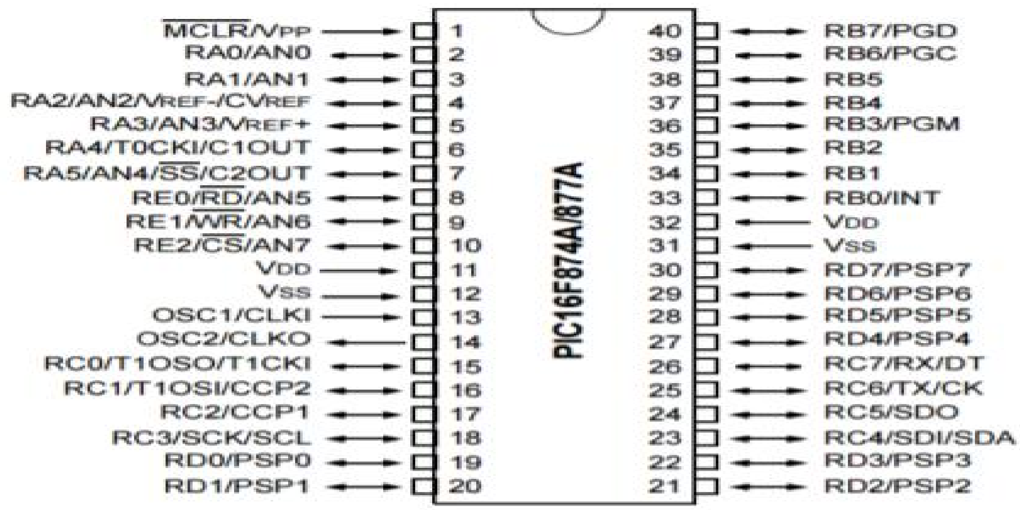
3.3 Electronic components:



The circuit of the smart light traffic control system is implemented based on various electronic components that include: the Programmable Intelligent Controller (PIC) 16F877A microcontroller, an LCD display device, XBee transceivers, a pair of IR sensors, push buttons (EA, EB, and 1 to 4), and many colored LEDs that represent the three lights (red, green, and yellow) of the traffic lights A and B associated with the roads 1 and 2 as well as the two lights (red and green) for the traffic light R and L associated with the deflection to the right and left in the direction of roads 3 and 4. A. Microcontroller PIC 16F877A The PIC 16F877A [19-23], a family of Harvard architecture microcontrollers made by Microchip, is an integrated circuit (IC) consisting of a simple Central Processing Unit (CPU), RAM, ROM, and EEPROM memories. It contains also clock, timers, A/D converters, and five input/output ports. On the other hand, its 35 instructions make it easy and simple to program. Moreover, its power consumption is low and it has a wide operating voltage range (2 V to 5.5 V) while its input clock operates at up to 20 MHz. The pin configuration of the PIC 16F877A microcontroller is shown in Fig. 2 where 5 bidirectional input/output ports can be classified as: A is a 6-bit general purpose port which can be also configured as Analog to Digital converter (A/D); B, C, and D are 8-bit general purpose ports, while port E is only 3-bit port. These ports are used to input data that may be generated from keypad, sensor, push button, switch, etc. or to present command signals or data to output devices such as LCD, 7- segment, LED, motor driver, relay, etc. Each port has its own associated TRIS register. The configuration of these TRIS registers is to select the data transfer direction between the microcontroller and the different peripheral devices through the ports. When a TRIS register is cleared, its corresponding port acts as output, otherwise it operates as input.

On the other hand, many microcontroller port pins can be extended to perform incremental functions and operate specific purposes. The PIC microcontroller is backed up by the Universal Synchronous Asynchronous Receiver Transmitter (USART) module that permits the PIC to communicate with wide range of devices. B. LCD display Liquid Crystal Display (LCD) [24] is a power economical, tenuous, flat-panel display, simply programmable, and can be used in many digital and electronic circuits. It employs a matrix structure in which the active element forming the pixel cell is located in the intersection of two electrode buses. Particularly, the 16x2 LCD used in the implemented prototype is able to display data over 2 lines, each of 16 characters.

Actually, two types of registers are used to configure the LCD; the command register is recommended for the control instructions as LCD initialization, clearing the screen, setting the cursor position, and controlling display. While the data register holds the ASCII code of the characters that are promptly appeared on the display.



IR sensor An infrared sensor is an electronic device implemented to detect obstacles or to differentiate between objects depending on its feature. It is generally harnessed to measure an object heat or its motion [25]. The IR sensor emits or receives the infrared radiations (430 THz – 300 GHz) that are invisible for the human eye. The LED (Light Emitting Diode) may act as an IR emitter while the IR detector is a photodiode component which is sensitive to IR light having the same frequency as the emitted radiation. The concept of operation is simple: when IR radiation of the LED reaches the photodiode, the output voltages change according to the magnitude of the IR light.

The XBee transceiver module, Series 2, allows creating complex mesh networks based on ZigBee firmware [26]. It admits a safe and simple full duplex communication between microcontrollers through serial port data transfer. The XBee features (2 mW output, 120 m range, built-in antenna, 250 kbps max data rate, and 8 digital IO pins) are suitable for our objective. Moreover, XBee is supported by point-to-point communication adequate for using one traffic light controller and corroborative also by multi-point network compatible for using multiple traffic controllers. In the XBee configuration, the component connected to portable controller runs as server whereas that linked to traffic light controller fills in the host mode. The XBee characteristics give immunity against interference from neighboring systems and avoid the interaction of closer systems which prohibit the interruption in their service

3.3.1 Density traffic light and IR sensors

TABLE I. TRAFFIC LIGHT CONFIGURATIONS DURING THE TWO MODES OF OPERATION

First configuration		Second configuration	
Phase I	*Phase II*	*Phase I*	*Phase II*
A-G ON A-Y OFF A-R OFF	A-G OFF A-Y ON A-R OFF	A-G OFF A-Y OFF A-R ON	A-G OFF A-Y OFF A-R ON
B-G OFF B-Y OFF B-R ON	B-G OFF B-Y OFF B-R ON	B-G ON B-Y OFF B-R OFF	B-G OFF B-Y ON B-R OFF
R-G ON R-R OFF	R-G ON R-R OFF	R-G OFF R-R ON	R-G OFF R-R ON
L-G OFF L-R ON	L-G OFF L-R ON	L-G ON L-R OFF	L-G ON L-R OFF

The major problem of the existing traffic light systems is that the transition timing slots are fixed within the code.
A similar system is unable to solve the situation where the traffic congestion is only observed from one direction. This state is frequently detected in many cities where employees from outskirts are driving in the morning to the city downtown and returning home in the evening. In addition, when the flow of cars approaching the intersection roads increases during the traffic peak hours or decreases during night, the green light activation should be extended or reduced respectively. Therefore, IR transceivers mounted on either side of roads are used to detect the passage of cars through it. The IR transmitter generates continuously and regularly a 38 kHz square wave signal while the IR receiver connected to the traffic master controller receives the signal and remains inactivated. When an automobile traverses the road between the IR transceivers, the IR radiation bounces and the system is activated. This activation process is analyzed by the traffic master controller where the car density counter is adjusted. Then, the traffic master controller, which is equipped with PIC microcontroller, responds to the acquired data. Actually, three modes of lighting transition slots are suggested: the normal mode, the traffic jam mode, and the soft traffic mode. The shifting between these three modes is done dynamically and in real time. In fact, the number of counted cars in the phase I of a given configuration affects directly the green light period in the next phase I of the proceeding configuration. The timing slots of the different modes are depicted in Table 2. The three timing slots associated to the normal, jam, and soft modes of traffic are respectively 30, 50, and 15 s. These levels are assigned by the code and can be adjusted by the software. For normal mode, the phase I of each configuration is equal to 30 s. However, if road 1 reveals jam traffic and road 2 shows soft traffic then the period of phase I of the first configuration will be 50 s. In contrast, the period of phase I of the second configuration will be 15 s. It is noted that during the first configuration, the cars of road 1 are moving to their destination while the cars of road 2 are stacked and parked. Furthermore, when phase II of the first configuration starts, the IR sensor of the road 1 begins the car counting from zero.

3.3.2 Emergency vehicles

One of the substantial situations in the traffic light system concerns the passage of emergency vehicles as higher priorities through the roads junction. An emergency vehicle includes ambulances, rescue vehicles, fire brigade, police, and VIP persons that could get stuck in the traffic congestion. This issue may cause several problems that depend on the injury of patient transported, person accident, fire buildings, robbery, and many various critical situations. It is mandatory to implement a technique to solve this predicament.

TABLE II. TIMING SLOTS ACQUIRED BY EACH CONFIGURATION AND ACHIEVED FOR THE THREE MODES OF TRAFFIC

Traffic Modes	**Configuration**	
	Phase I	***Phase II***
Normal traffic	30	5
Jam traffic	50	5
Soft traffic	15	5

A handheld portable device at the disposition of the traffic officer is proposed in order to command the traffic master controller. Indeed, the portable controller could be adjusted to be mounted on emergency vehicles or implemented in the traffic control center. The portable device is supported by two push buttons labeled EA and EB. The EA button is pressed when the emergency vehicle arrives at the intersection from the side of traffic light A, that is from road 1. Due to this action, the phase I of the first configuration is set and the green light timing slot is shining unlimitedly to provide sufficient time to the stacked vehicle to traverse the intersection. Next, the EA button is pressed again to return to the normal mode, where the yellow light of the traffic light A is ON for 5 s to warn the drivers that traffic light B will be closely triggered. If the elapsed time exceeds 4 minutes and the EA button is still operating for many causes, the system is automatically actuated and initiates the second configuration. The EB button applied to the traffic light B achieves similar process. If the two buttons are pressed simultaneously, the priority is given to the button EA.

3.3.3 GPS Module

Our smart traffic controlling system needed a GPS module that was small, fast and accurate, consume as little power as possible, and was easy to interface with the existing control board. We looked at three different GPS receivers and chose the best one that would meet our requirements.

3.4.4 Battery/Power Supply

For our project we need a power supply that is low cost, light weight, reusable, and has enough power for at least ten minutes of flight. Rechargeable batteries were chosen for our project due to reuse value. Currently there are three main types of rechargeable batteries available commercially for radio controlled models, nickel-cadmium (NiCad), nickel-metal hydride (NiMH), and lithium polymer (LiPo) batteries.

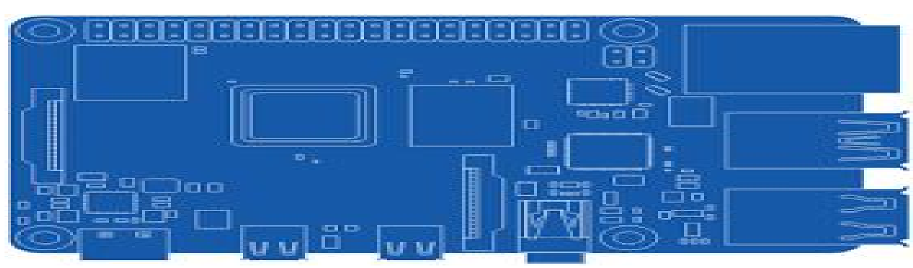
NiCad batteries have a low internal resistance that allows for high-power output, can operate a large temperature range, but suffers from "memory" loss. This term memory refers to the amount of capacity the battery can store after each discharge. The overall capacity of the NiCad battery will decrease over a duration of time. NiMH batteries are similar to NiCad batteries except they can hold 30% more capacity, but suffer from a larger memory loss .

LiPo batteries can hold 30% more capacity and are much lighter than a NiMH battery. LiPo batteries also suffer from a lower memory loss compared to the NiMH battery. The disadvantages to this battery are that these type of batteries are prone to overheating and overcharging the bat-teries could lead to fire. Extreme care must be taken when using these type of batteries .

Due to these reasons, our group has chosen to use a LiPo battery. At this point and time we had just started choosing parts for our quadcopter. To choose the size of battery we had to make some calculations. All calculations and measurements were based on datasheet specifications. To calculate the amount of thrust we needed to overcome gravity, the overall weight of the quadcopter and all its components was found to be about 1550 grams. We may want to add extra components in the future, so we made these calculations with that in mind and assumed the total weight to be 1800 grams. Our quadcopter has four motors, therefore 450 grams of thrust was needed for each motor to overcome the forces of gravity.

3.4 Raspberry pi

A Raspberry Pi is a credit card-sized computer originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. But thanks to its small size and accessible price, it was quickly adopted by tinkerers, makers, and electronics enthusiasts for projects that require more than a basic microcontroller (such as Arduino devices).The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level.



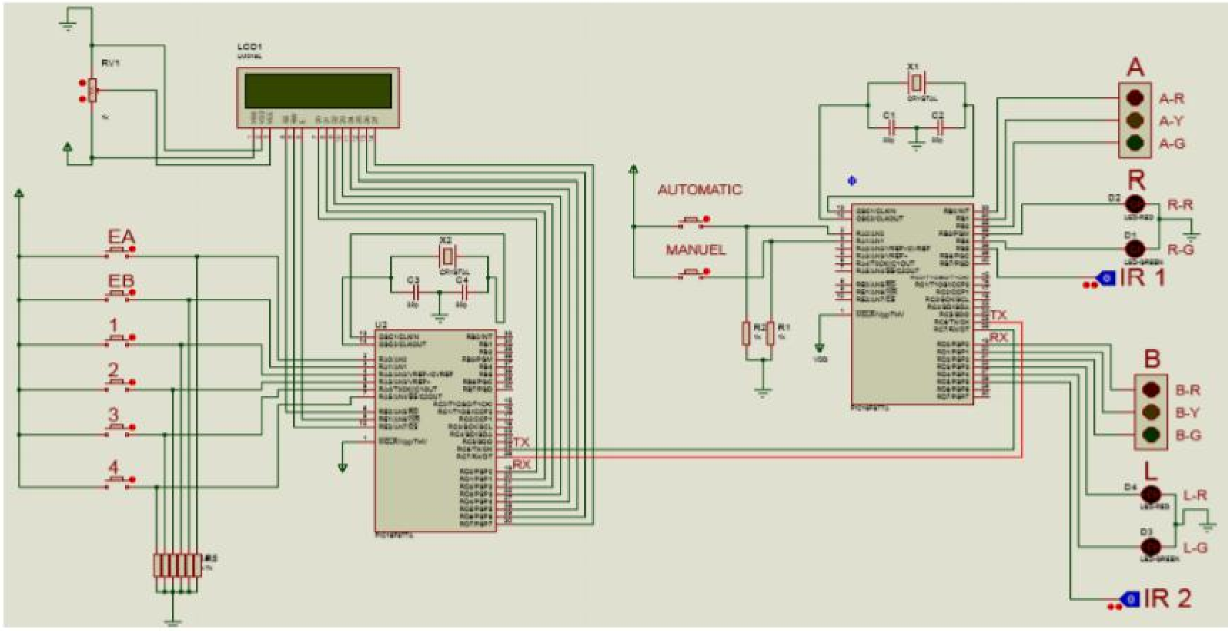
Raspberry Pi 4 Model B specifications

3.5 HARDWARE DESIGN:

The smart light traffic control system is composed of two separate devices: the traffic master controller and the handheld portable controller. Fig. 3 shows the hardware implemented circuit of the smart traffic controller using the Proteus software. The traffic master controller is mounted with the traffic lights at the roads intersection and is responsible for the lighting transition and their timing slots. Its implemented design circuit includes: the PIC 16F877A microcontroller, the three lights (red, green, and yellow) of the traffic lights A and B associated to the roads 1 and 2, the two lights (red and green) for the traffic light R and L associated with the deflection to the right and left in the direction of roads 3 and 4, the two IR receivers to measure the traffic volume, the XBee transmitter system, and other basic components. The traffic master controller provides the duration and the schedule of the two configurations and their dedicated phases for different modes of traffic. It determines the status of the different lights by commanding the triggered switches connected to the PIC ports. The microcontroller is also connected to IR detectors whose output voltages are responsible of shifting the counter of the cars arriving at the intersection. Finally, the XBee module receives the command orders form the portable controller and calls the corresponding emergency subroutines. The portable controller commands the traffic master controller by means of XBee transceiver that communicates wirelessly with the other XBee component. A PIC 16F877A constitutes the hardware core of the portable controller. It is connected, in addition to XBee, to the buttons EA and EB that start up the emergency subroutines. An LCD screen is employed to notify the user if the mode of emergency is operating and which emergency procedure is currently running. We propose also a password of 6 digits formed by the combinations of 4 digits from 1 to 4 in order to supply the portable controller by a certain security level [27]. The total number of arrangements is 4096 possibilities. The role of security code is to prevent unauthorized persons from accessing to the smart light system.

The traffic light issue is obviously a critical problem that worries citizens and governments. The influence of low efficient conventional traffic system affects the economic, health, financial, and environmental domain.

The transportation system trouble and the bad monitoring may cause car accidents, traffic jam, and roads congestion that put heavy loads on businesses and works. The advancement of technologies and the miniature of control devices, appliances and sensors have given the capability to build sophisticated smart and intelligent embedded systems to solve human problems and facilitate the life style. Our smart traffic light control system endeavors to contribute to the scientific society to ameliorate the existing traffic light systems and manage the flow of automobiles at the intersections by implementing innovated hardware and software design systems.

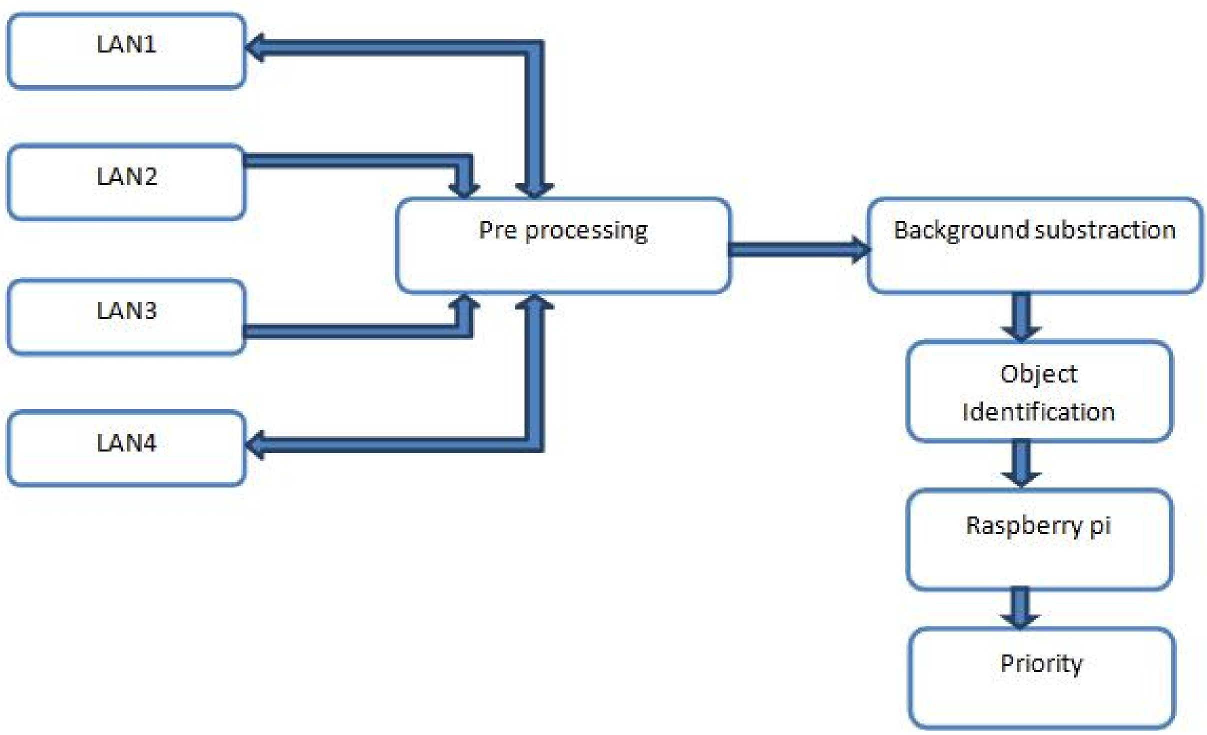


3.6 <u>SUMMARY:</u>

The proposed smart traffic system consists of a traffic light controller that manages the traffic lights of a "+" junction of mono directional roads. The system is capable of estimating the traffic density using IR sensors posted on either side of the roads. Based on this information, the time dedicated for the green light will be extended to allow large flow of cars in case of traffic jam, or reduced to prevent unnecessary waiting time when no cars are present at the opposite route. The system is complemented by portable controller for the emergency vehicles stuck in the traffic. By means of secure communication using XBee wireless system, the portable controller triggers the traffic master controller to the emergency mode and provides an open path until the stuck emergency vehicle traverses the intersection. The designed system is implemented, realized electronically, and tested to ensure complete validation of its operations and functions. The current design can be promoted by monitoring and controlling an intersection with double roads. Future improvements can be added such as pedestrian crossing button, delay timing displays, as well as car accident and failure modes. The integration of different traffic controllers at several junctions will be investigated in the future in order to accomplish a complete synchronization. To study the system performance, traffic data can be recorded and downloaded to computer platform where statistical data analysis studies could be applied to better understand the traffic flows between the intersections. Finally, traffic light controller could be powered by solar power panels to reduce grid electricity consumption and realize green energy operations.

4. INNOVATION IN PROJECT:

The frequent traffic jams at major intersections call for an effective management system. The paper suggests implementing a smart traffic controller using real-time image processing. The sequence of the camera is analyzed using different edge detection algorithms and object counting methods. Previously they used matching method that means the camera will be installed along with traffic light. It will capture the image sequence. To set an image of an empty road as a reference image, the captured images are sequentially matched using image matching; but in my paper, we used filtering method, which filtered the image and released all waste objects and only showed the cars, and after it well showed the number of cars in image. My paper is software that takes a picture or video. It has been customized to be used in the future to control the traffic light sign by giving each sign sufficient time, depending on the number of cars on each direction.



4.1 Architecture Design:

Figure 1 gives an overview of the moving vehicle detection in a video sequence. The system makes use of an existing video sequence.

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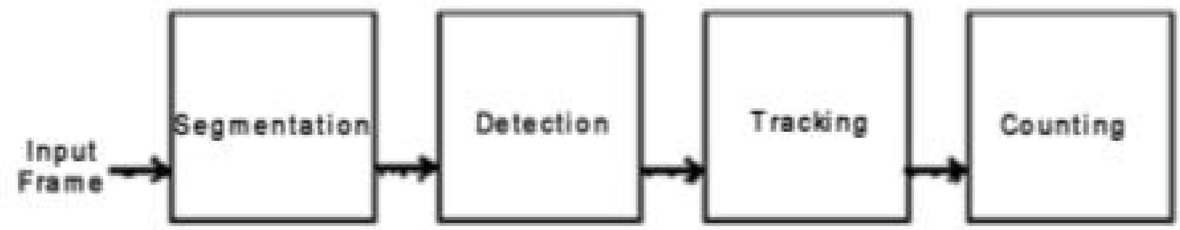
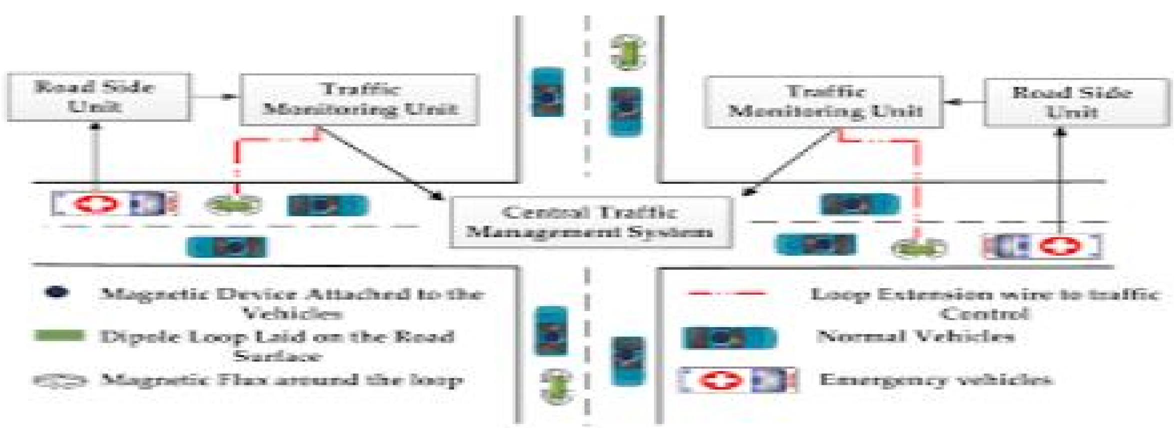


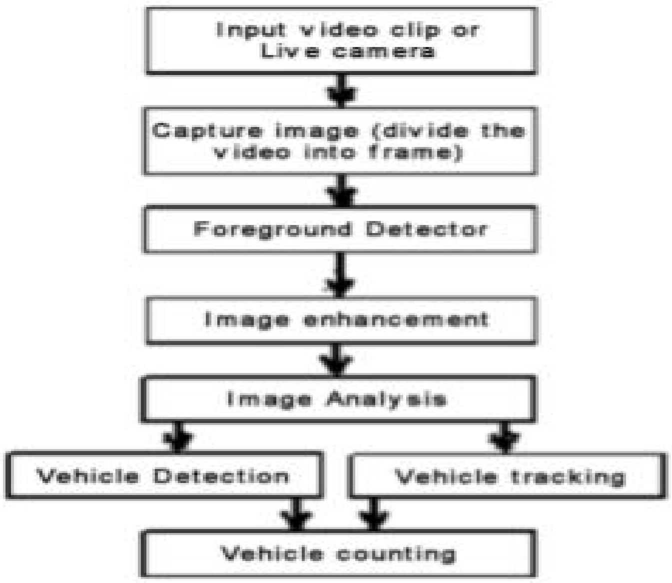
Figure 1. Overview of vehicle detection and counting system.

The video is divided into frames, and is taken as the input frames. They are entering into foreground method to eliminate the background and many roles. If a vehicle is present in the input frame, it will be retained. The detected vehicle is thus tracked by various techniques, namely, blob analysis method.



4.1.3 Block diagram:

The Block diagram below gives an overview of how the vehicle is detected using image processing. Various boxes in Block diagram are explained below:



The Basic Model of Smart Traffic Light Controller System is shown in Fig.2. In proposed model the junctions are shown by letter A, B and C. To detect traffic length the Infra-Red sensors are mounted on road side at each junction. Sensors detect the traffic level and provide this as input to computer system where it decides time period for each red, green and orange light for which it remains in glowing state. As shown in figure, if there is heavy traffic congestion at junction A then through SMS, car driver will be informed about congestion so that he can decide to take another route i.e. route 1 passing by C on their mobile phone[1]. In addition to above, in the emergency mode, for a vehicle like ambulance, fire fighter or police car, the signals are altered for the fast and easy movement of these vehicle. Consider Fig.2, if an emergency vehicle Design Of Smart Traffic Light Controller Using Embedded System www.iosrjournals.org 33 | Page is passing by the route A-B, the signals on the roads which are crossing this route will be immediately made red to stop vehicles on these routes. This is a very important feature which is very useful in case of emergency. The basic operation of STC can be realized using embedded system and sensor network. In this model control circuit and computer system, parallel communication interface, API is used.

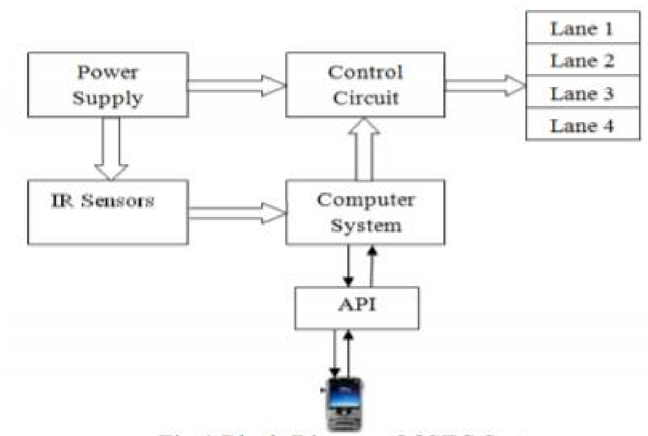
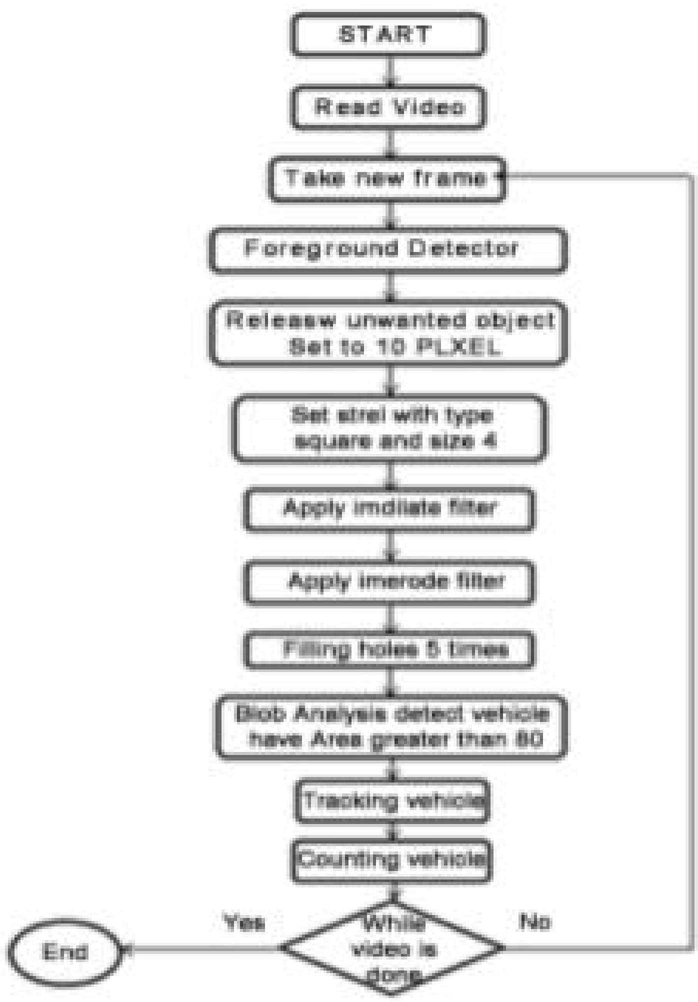


Fig.1.Block Diagram Of STC System

4.1.4 Algorithm Flowchart:



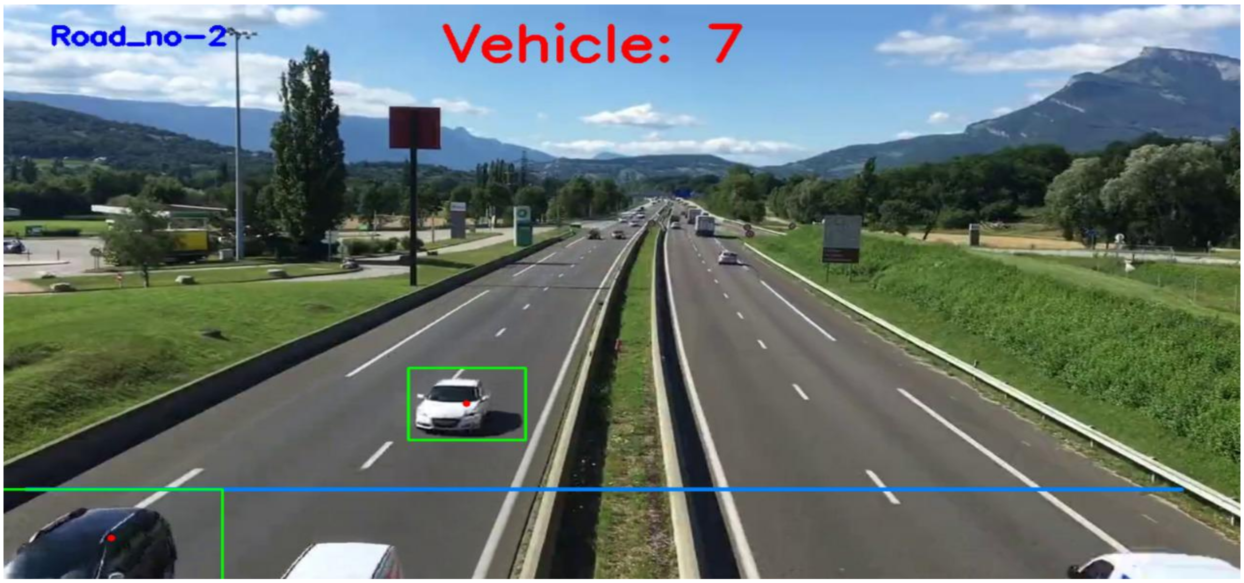
4.2 IMPLEMENTATION:

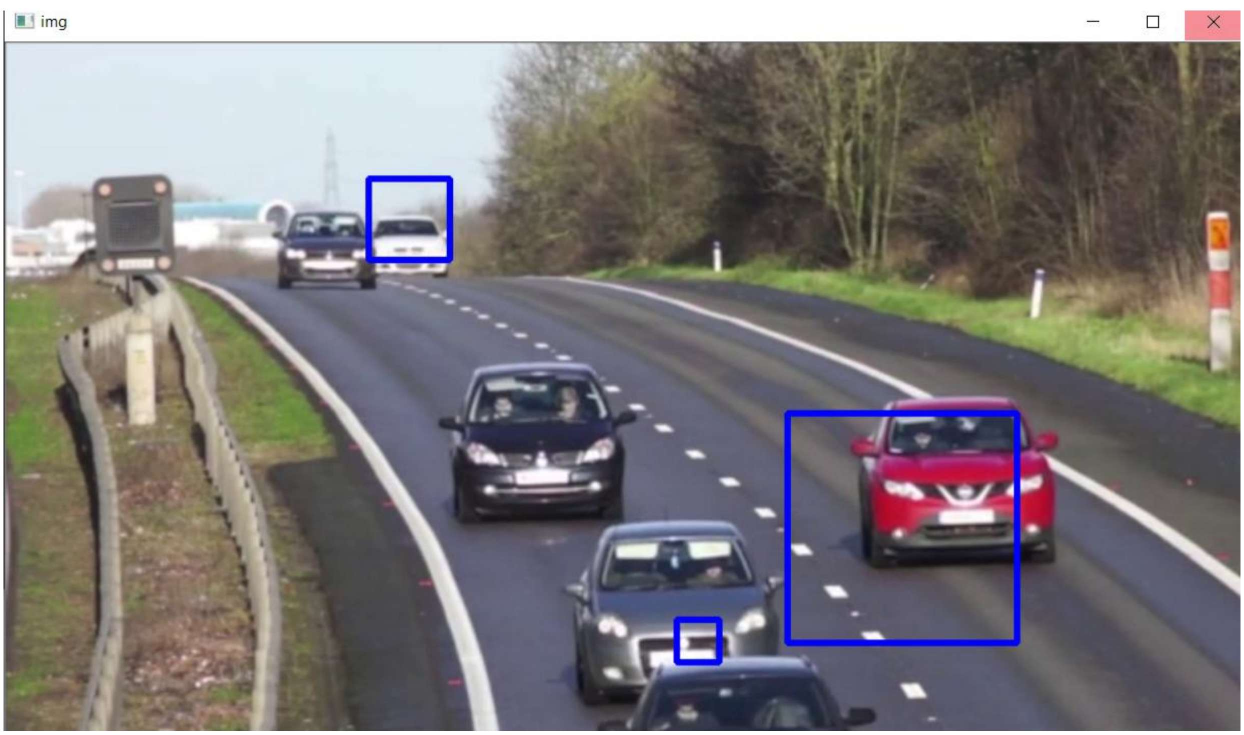
```
import cv2

face_cascade = cv2.CascadeClassifier('cars3.xml')
# Read the input image
#img = cv2.imread('test.png')
cap = cv2.VideoCapture('training_video.mp4')

while cap.isOpened():
    _, img = cap.read()

    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    faces = face_cascade.detectMultiScale(gray, 1.1, 4)

    for (x, y , w ,h) in faces:
        cv2.rectangle(img, (x,y), (x+w, y+h), (255, 0 , 0), 3)

    # Display the output
    cv2.imshow('img', img)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

cap.release()
```

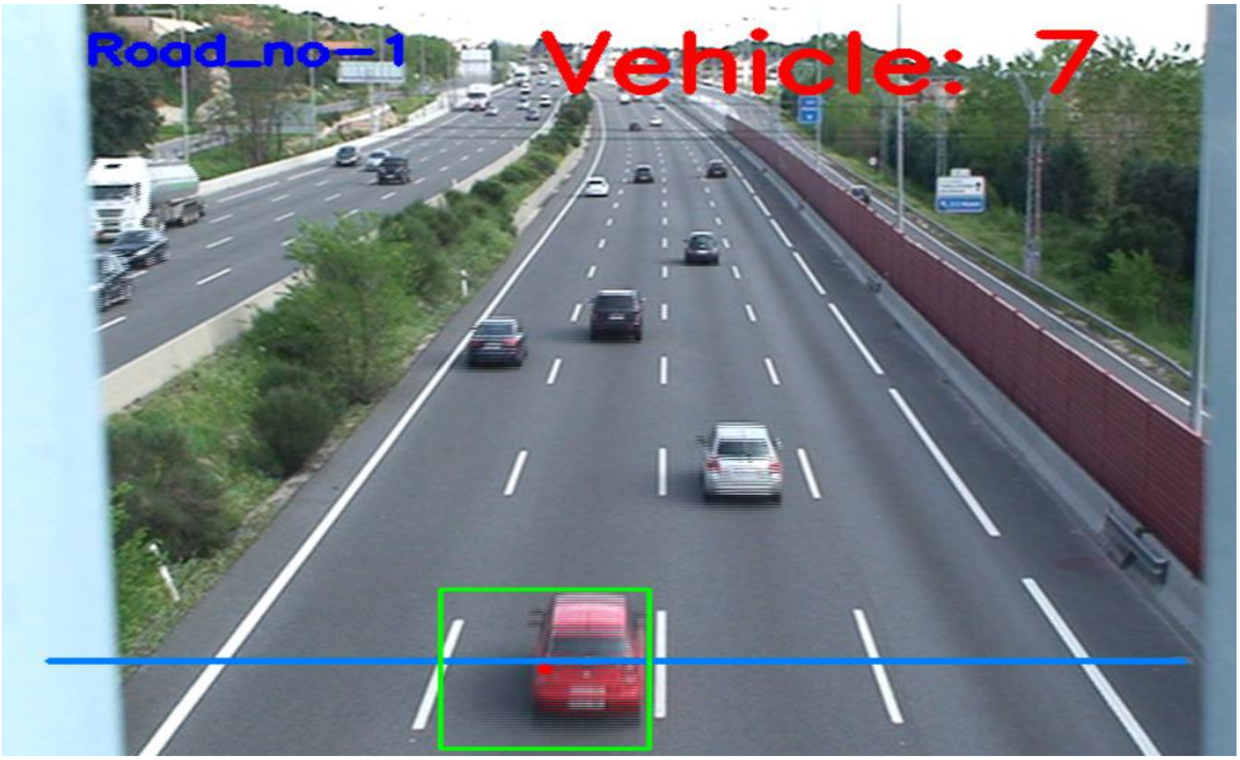
```
import traffic1 as t1
import cv2
import numpy as np
from time import sleep
def Vehicle():
    width=80
    height=80

    offset=6

    line=600

    delay= 60 #FPS do vídeo

    detec = []
    count= 0


    def handle_centre(x, y, w, h):
        x1 = int(w / 2)
        y1 = int(h / 2)
        cx = x + x1
        cy = y + y1
        return cx,cy

    cap = cv2.VideoCapture('video.mp4')
    subtracao = cv2.createBackgroundSubtractorMOG2( history = 5,varThreshold = 25,detectShadows = True )
```

```python
while True:
    ret , frame1 = cap.read()
    tempo = float(1/delay)
    sleep(tempo)
    grey = cv2.cvtColor(frame1,cv2.COLOR_BGR2GRAY)
    blur = cv2.GaussianBlur(grey,(3,3),5)
    img_sub = subtracao.apply(blur)
    dilat = cv2.dilate(img_sub,np.ones((5,5)))
    kernel = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (5, 5))
    dilatada = cv2.morphologyEx (dilat, cv2. MORPH_CLOSE , kernel)
    dilatada = cv2.morphologyEx (dilatada, cv2. MORPH_CLOSE , kernel)

    img,contorno,h = cv2.findContours(dilatada,cv2.RETR_TREE,cv2.CHAIN_APPROX_SIMPLE)
    cv2.line(frame1, (25, line), (1200, line), (255,127,0), 3)
    cv2.line(frame1, (25, line), (1200, line), (255,127,0), 3)
    for(i,c) in enumerate(contorno):
        (x,y,w,h) = cv2.boundingRect(c)
        validar_contorno = (w >= width) and (h >= height)
        if not validar_contorno:
            continue

        cv2.rectangle(frame1,(x,y),(x+w,y+h),(0,255,0),2)
        centro = handle_centre(x, y, w, h)
        detec.append(centro)
        cv2.circle(frame1, centro, 4, (0, 0,255), -1)

        for (x,y) in detec:
            if y<(line+offset) and y>(line-offset):
                count+=1
                cv2.line(frame1, (25, line), (550, line), (0,127,255), 3)
                detec.remove((x,y))
                print("cars detected a moment: "+str(count))
            if count == 10:
                t1.Vehicle()
```

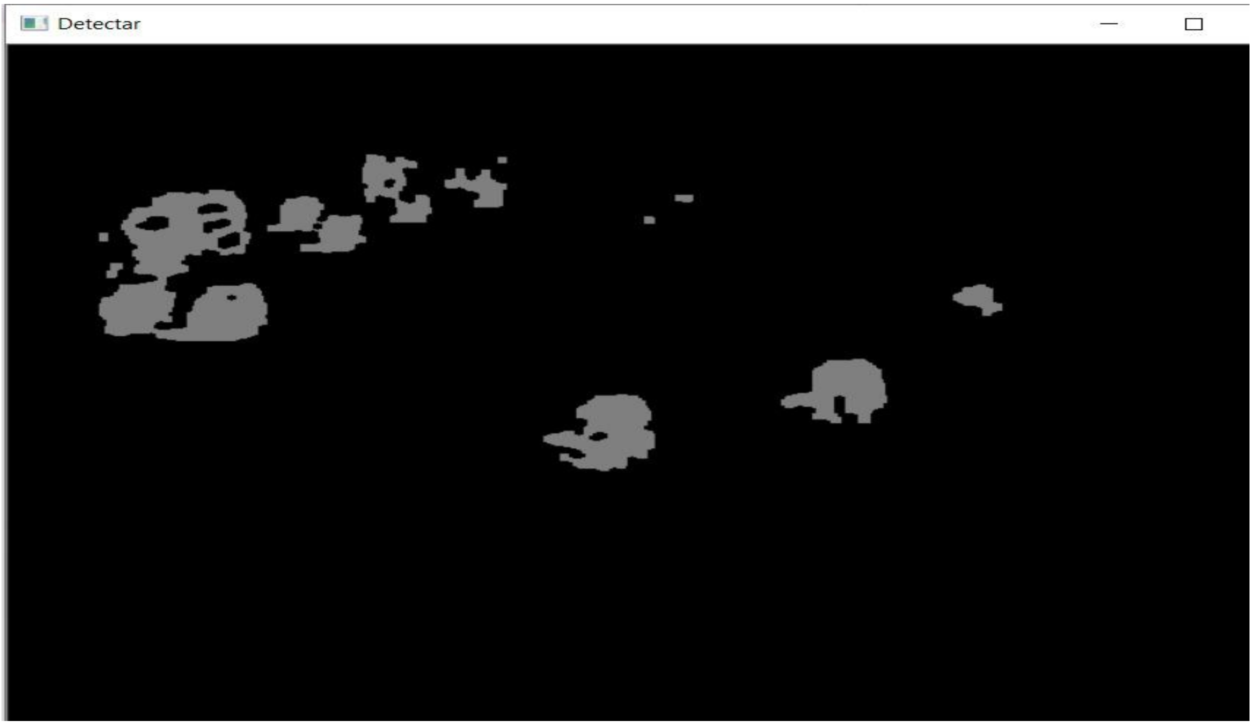
4.2.1 OUTPUT








```
cars detected a moment: 1
cars detected a moment: 2
cars detected a moment: 3
cars detected a moment: 4
cars detected a moment: 5
cars detected a moment: 6
cars detected a moment: 7
cars detected a moment: 8
cars detected a moment: 9
cars detected a moment: 10
cars detected a moment: 1
cars detected a moment: 2
cars detected a moment: 3
cars detected a moment: 4
cars detected a moment: 5
cars detected a moment: 6
cars detected a moment: 7
cars detected a moment: 8
cars detected a moment: 9
cars detected a moment: 10
cars detected a moment: 1
cars detected a moment: 2
cars detected a moment: 3
```


Detectar

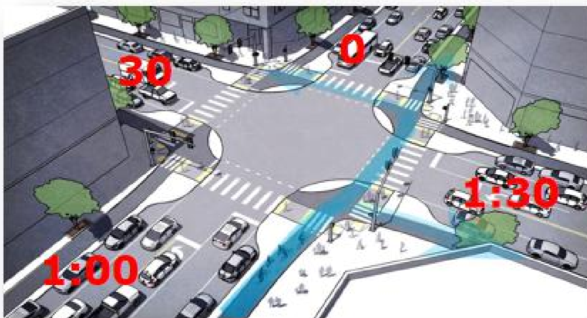

Detectar

problem: *there is a fixed timer on traffic signal They can't change the time in basics of traffic on the road .*

Solution: we have use traffic camera to input in our software then count the vehicle on each road then control the signal and Change the timer in the basics of traffic on the road .

Technology : Machine Learning , Python(Anaconda), Opencv(module)AI .

Problem



Solution/prototype

4.3 Discussion

Traffic light control systems are widely used to monitor and control the flow of automobiles through the junction of many roads. They aim to realize smooth motion of cars in the transportation routes. However, the synchronization of multiple traffic light systems at adjacent intersections is a complicated problem given the various parameters involved. Conventional systems do not handle variable flows approaching the junctions. In addition, the mutual interference between adjacent traffic light systems, the disparity of cars flow with time, the accidents, the passage of emergency vehicles, and the pedestrian crossing are not implemented in the existing traffic system. This leads to traffic jam and congestion. We propose a system based on PIC microcontroller that evaluates the traffic density using IR sensors and accomplishes dynamic timing slots with different levels. Moreover, a portable controller device is designed to solve the problem of emergency vehicles stuck in the overcrowded roads. Keywords—Traffic light system; microcontroller; XBee wireless communication; IR sensor; traffic density.

The design of intelligent traffic control system is an active research topic. Researchers around the world are inventing newer approaches and innovative systems to solve this stressful problem. Models based on mathematical equations are applied to estimate the car waiting time at a junction, the number of cars in the waiting queue, the extension of the waiting cars along the lane, the optimal timing slots for green, yellow, and red lights that best fit the real and veritable situation and the efficient combination of routing. In fact, the mutual dependencies between nearby intersections lead to a complicated formulation with cumbersome parameters. These parameters are accidental, hazardous, dependent, and the worse point is the variance of these parameters with time. Thus, finding a dynamic, consistent, and convenient solution is quite impossible. Researchers from different disciplines are collaborating to explore feasible solutions that reduce traffic congestion. Therefore, various methodologies are constantly proposed in the literature and many techniques are implemented profiting from the technological advances of microcomputers, recent manufactured devices and sensors, and innovative algorithms modeling, as much as possible, the complication of traffic lights.

5. CONCLUSIONS:

The traffic light issue is obviously a critical problem that worries citizens and governments. The influence of low efficient conventional traffic system affects the economic, health, financial, and environmental domains. The transportation system trouble and the bad monitoring may cause car accidents, traffic jam, and roads congestion that put heavy loads on businesses and works. The advancement of technologies and the miniature of control devices, appliances and sensors have given the capability to build sophisticated smart and intelligent embedded systems to solve human problems and facilitate the life style. Our smart traffic light control system endeavors to contribute to the scientific society to ameliorate the existing traffic light systems and manage the flow of automobiles at the intersections by implementing innovated hardware and software design systems. The proposed smart traffic system consists of a traffic light controller that manages the traffic lights of a "+" junction of mono directional roads. The system is capable of estimating the traffic density using IR sensors posted on either side of the roads. Based on this information, the time dedicated for the green light will be extended to allow large flow of cars in case of traffic jam, or reduced to prevent unnecessary waiting time when no cars are present at the opposite route. The system is complemented by portable controller for the emergency vehicles stuck in the traffic. By means of secure communication using XBee wireless system, the portable controller triggers the traffic master controller to the emergency mode and provides an open path until the stuck emergency vehicle traverses the intersection. The designed system is implemented, realized electronically, and tested to ensure complete validation of its operations and functions. The current design can be promoted by monitoring and controlling an intersection with double roads. Future improvements can be added such as pedestrian crossing button, delay timing displays, as well as car accident and failure modes. The integration of different traffic controllers at several junctions will be investigated in the future in order to accomplish a complete synchronization. To study the system performance, traffic data can be recorded and downloaded to computer platform where statistical data analysis studies could be applied to better understand the traffic flows between the intersections. Finally, traffic light controller could be powered by solar power panels to reduce grid electricity consumption and realize green energy operations.

The smartness of traffic signal controller is introduced in this project with powerful functions and hardware interface. The software API provides easy interface to the administrator. Proposed system works efficiently over the present traffic controlling system in respect of less waiting time, efficient operation during emergency mode and suggesting alternate route.

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