Automated Traffic Control Network Using Secure Wireless

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Abstract- Traffic being the most serious problem in the present overcrowded world, several mishaps occurs in our day to day life. In this paper we have tried to develop an algorithm which will try to overcome this problem. The algorithm that we developed tracks the incoming ambulance or fire engine and the traffic signal automatically turns green and hence provide a smooth flow of these vehicles in even heavy traffic. Original signal is restored as soon as the vehicle moves out of the scanning vicinity of the traffic signal. Moreover, to avoid being stuck in congestion on a particular route, the user can just enter the destination and the program shall provide the user with the optimum path both in terms of traffic congestion and distance, along with other possible paths.

Index items– Automated traffic control, Bluetooth, cryptography, python programming, and wireless network.

MOTIVATION

In India rapid growth of population coupled with high rate of industrialization has resulted in unmanageable increase in traffic volume, especially in metropolitan cities and urban areas. Due to this increase in traffic density several valuable lives are lost due to delay in receiving medical attention. So we designed a system which prioritizes emergency vehicles like ambulances, fire engines and provide them with a congestion free path to reach its destination as soon as possible.
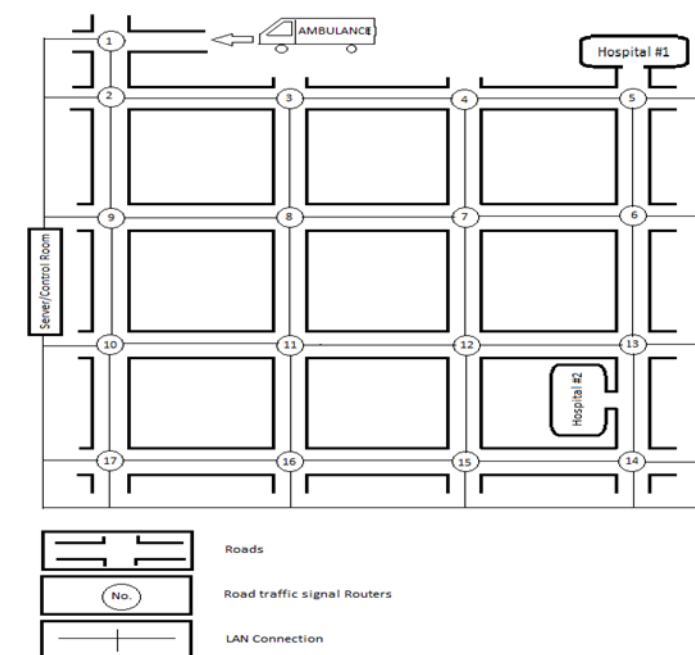
PROBLEMS:

One of the most challenging problems of urban civilization is directly or indirectly related to population explosion, traffic congestion being one of the most persistent one. Not only it wastes our valuable time but also in some cases situations can go critical.

- Traffic congestion hampers the speed of vehicles which also include emergency vehicles like ambulances, police van and fire engines whose delay can put life of many at risk.
- Unnecessary waiting at the traffic signals due to unequal traffic density
- Absence of knowledge about the routes of a city.
- Handling huge traffics can get daunting at times.

It's the emergency services which pay the maximum price when caught in traffic jams especially the ambulance services where situations can be very critical. To solve this problem we have come up with the solution of **automated traffic control using secure wireless network.**

Using this technology we make traffic signals automatically green as any ambulance comes in its vicinity, thereby minimizing the unnecessary time spent in traffic jams. As a result it gets a clear path to carry the patient to a nearby hospital which can be at times quite vital to save one's life. Moreover we find all the available paths from the current position of the vehicle to the hospital, highlighting the shortest or optimal path., this facility can also make up for the meager knowledge of routes of the driver. It also solves the problem of language barrier which is experienced by many drivers who are new to a completely cultural diverse location where our program proves to be quite useful.

Since the changing of signals is completely automated we make the task of traffic operators quite hassle free and comfortable.

This facility further enables us to deal traffic according to its density. It's unnecessary to keep a whole lot of vehicles waiting at a 'red' signal for 60secs than letting few vehicles pass through 'green' signal for that equal amount of time. The path which has higher traffic density faces 'red' signal for lesser time and more of green signal and vice versa. This greatly enhances the mobility of the vehicles

As automated systems are taking over the manual ones due to their increased efficiency and human error free nature, introduction of this technology takes it to an advanced level.

I. INTRODUCTION

We aim to develop an automatic traffic control system which can function independent of any outside help. Our traffic control system is equipped with a distinct feature especially for ambulance through which it is being assigned priority in terms of getting a green signal ahead of normal vehicles. Along with

that we are also determining the optimum path between any source and destination. But the most crucial point is that we are providing all these facilities with the help of very cheap and widely available technologies, which makes us distinct from others.

We implemented the following technologies in this project:
- Python (as coding language)
- Bluetooth(as a mode of communication)
- Cryptography(to enhance system security)

PYTHON

What is Python?
Python is a general-purpose, high-level programming language whose design philosophy emphasizes code readability. Python language stands out in comparison with respect to other programing languages as it:
- Has a vast array of standard library
- Has code readability.
- Supports multiple programming paradigms
- Includes object-oriented, imperative and functional programming styles
- Is compact -
  Unlike its predecessors like java and C++, in python the length of code to perform an equivalent task is less so it reduces the memory consumption.
- Can be packaged into standalone executable file which can cater to our several needs by using third party tools
- Provides a simpler and better way to represent data in graphical form-
  Modules like matplotlib, visual provides us with the facility of mapping data in 2-D and 3-D form.
- Supports meta class based meta programming.
- Has an environment that is reasonably secure from tampering. Pre-compiled python modules can be distributed to prevent altering the source code
- Is an interpreted language, that allows for rapid, flexible, exploratory software development
- Is an example of a FLOSS (Free/Libra and Open Source Software)

Why python?
Python language stands out in comparison with respect to other programming languages in terms of its vast array of standard library and code readability. We chose it over other languages as it
is more compact and also by using third party tools python code can be packaged into standalone executable file which can cater to our several needs. We have used third party modules like Bluetooth, matplotlib, pysqlite, cipher and visual. Bluetooth module helps us to perform the scanning and tracking operation. Python provides a simpler and better way to represent data in graphical form, in comparison to any other programing language. We did the implementation of the above with the help of module matplotlib. We have connected database to python with the module pysqlite as we need database connection in our project to bring coordination between the traffic signals. To provide security to the files used in the project from unscrupulous elements, we used the module

cipher. Along with 2D projection of graph, python also provides a more user friendly and sophisticated 3D projection technology using the module visual. By this module, we can easily form a sphere or other known figure in only a single statement, which in comparison, takes several steps in other programming language to accomplish.

Python over Java
- **Concise Coding style**: The code in Python is typically much more concise than that of Java, with much lesser verbosity.
- **Dynamic Typing:** No requirement of declaring data types in Python making sure that the inheritance hierarchies especially for all the interfaces and implementations are well laid out.
- **Easier Runtime Reflection:** Java has most of the reflection capabilities but they are harder to use as compared to Python.
- **Built in language capabilities:**Python has more built in language capabilities than Java. Items such as list comprehensions, ability to deal with functions as first class objects gives a broader vocabulary to work with.
- **Clean indentation:** Indentation of the code is required in Python which may be considered as a drawback over Java, but the clean indented code is much easier to read and handle with errors.

DISADVANTAGE OF PYTHON-

- Because Python is an interpreted language the programs written using it can be slower for certain classes of problems. For example, doing some intense computations.
- No access specifiers and hence viable to security issues

What is Bluetooth?
Bluetooth is a wireless technology standard for exchanging data over a short distance in a very efficient and lucid way. It is a technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400–2480 MHz) from fixed and mobile devices, creating personal area network (PANs) with high levels of security. Created by telecom vendor Ericson in 1994 it was originally conceived as a wireless alternative to RS-232 data cables.

Why Bluetooth?
- It is very cheap and easily available
  -A Bluetooth adapter costs very less (around 200 INR) and can be found easily in the market. Therefore its maintenance can be done easily
- It can connect several devices, overcoming problems of synchronization-
- It is very easy to install-
  Unlike its other connecting devices it consumes very less power so it can operate without an external source.

- Quite efficient and robust-
  A Bluetooth device is not affected by any external agent like weather conditions, presence of other devices.

- Delay in scanning turns out to be beneficial for our project-
  In our project Bluetooth scanners are installed at every node which is scanning for the vehicles continuously .A time lag of eight seconds between any two subsequent scans gives us suitable response time for changing the signals. In an average case, a vehicle within 30 feet of the junction of a crossroad will take less than eight seconds to move out of the coverage area. Thus this delay helps us to eliminate the repeated detection of same vehicle within a span of time.

- Limited area of access proves to be quite an advantage for our project-
  Detecting a vehicle at a distance greater than 50 feet away seems to be quite unnecessary as it will keep the signal 'green' for a longer period of time than desired. So a 30-feet range of access proves to be quiet appropriate.

- Does not interfere with normal signaling of devices-
Since our project mainly deals with ambulance and other emergency vehicles which can contain sophisticated and sensitive devices .These devices can get easily affected by the interference of an external signal and Bluetooth just avoids that.

Why better than Wi-Fi?
- Cost effective-
  Cost of setting a Bluetooth in comparison to Wi-Fi is much less.

- Interferes with external signaling of devices-
  At the time of functioning, Wi-Fi devices tend to interfere with signaling of surrounding devices which can prove quite harmful in several cases when dealing with certain sophisticated and life saving devices.
- Lower power consumption and easy to maintain-
  A portable device's primary need is that it should consume less amount of power, but Wi-Fi devices require larger amount of power to function properly which makes it quite inappropriate within the context of our project.

Why better than RFID?
- Data transfer rate comparatively faster-
  In RFID bit wise data transfer takes place but in Bluetooth a bulk of data can be transferred in no time which makes it better in cases which require a large amount of information storing and sharing.

- Area of access too small for our project;
  RFID can be accessed for a very small distance which is quite impractical with respect to our project.
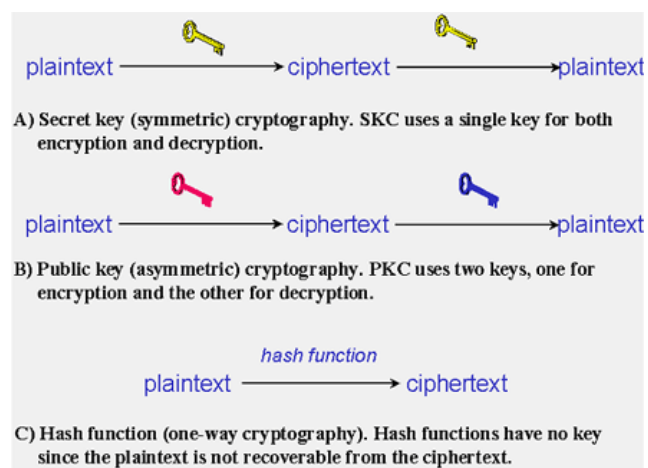
What is cryptography?

Cryptography is the science of information security. It is about construction or formation of some basic protocols to overcome the influence of adversaries. Modern cryptography concerns itself with the following four objectives:
- **Confidentiality** -the information cannot be understood by anyone for whom it was unintended.
- **Integrity** -the information cannot be altered in storage or transit between sender and intended receiver without the alteration being detected.
- **Non-repudiation** -the sender of the information cannot deny at a later stage his or her intentions in the creation or transmission of the information.
- **Authentication** -the sender and receiver can confirm each other's identity and the origin & destination of the information.

Generally there are three types of cryptography techniques-

- Secret Key Cryptography (SKC): Uses a single key for both encryption and decryption
- Public Key Cryptography (PKC): Uses one key for encryption and another for decryption
- Hash Functions: Uses a mathematical transformation to irreversibly "encrypt" information

plaintext → ciphertext → plaintext

A) Secret key (symmetric) cryptography. SKC uses a single key for both encryption and decryption.

plaintext → ciphertext → plaintext

B) Public key (asymmetric) cryptography. PKC uses two keys, one for encryption and the other for decryption.

hash function
plaintext → ciphertext

C) Hash function (one-way cryptography). Hash functions have no key since the plaintext is not recoverable from the ciphertext.

How cryptography actually works?

The word 'crypto' means hidden. Encryption is the process of converting ordinary information called plaintext into unintelligible gibberish called cipher text and decryption that is the reverse, in other words, moving from the unintelligible cipher text back to plaintext. The set of algorithms or functions that are responsible for encryption and decryption sequence is called key.
The encryption and decryption process can be performed using various methods or standards.in this project we are use Data Encryption Standards (DES).DES is the archetypal block cipher with block size is 64 bits. The key used in DES ostensibly consists of 64 bits; however, only 56 of these are actually used by the algorithm. Eight bits are used solely for checking parity, and are thereafter discarded. Hence the effective key length is 56 bits, and it is always quoted as such. Every 8th bit of the selected key is discarded, that is, positions 8, 16, 24, 32, 40, 48, 56, 64 are removed from the 64 bit key leaving behind only the 56 bit key.

What is the need of cryptography?

Our project deals with full automation of traffic signals which

disseminating information from medical sensors to the servers. In this project Wi Fi could have been used but RF radiation emitted by it interferes with medical devices and may also cause health hazards. The bandwidth requirement of Bluetooth
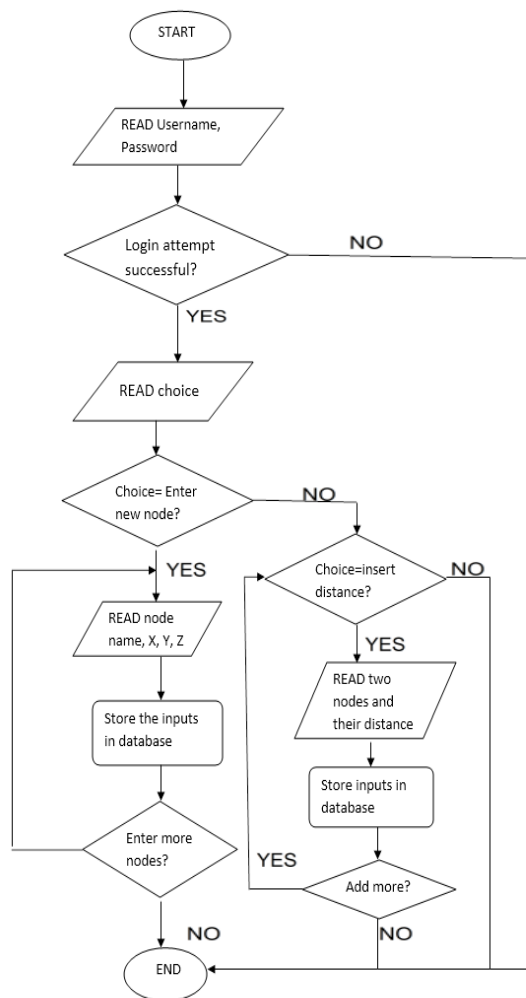
is vulnerable to any kind of anti-social activities which can prove quite troublesome. At the time when database is edited through scanner which is the deciding factor in management of the traffic lights any interference from any foreign unscrupulous element will make the whole situation more chaotic and can disrupt the whole traffic system. So by securing it we are trying to avert or avoid any such activities.

II. RESEARCH ELABORATION

In this section we mention about previous works which have motivated us in implementing this project. We have seen a number of projects which used Bluetooth Scanning devices for various purposes. Coding of various projects is also done using python. The combination of Bluetooth and python has helped in developing different types of projects. In the paper 'WRife:a' wireless epidemic data collection protocol suitable for medical monitoring' by students of Texas University, we see that patient's health related data is collected using medical sensors. Fixed and mobile radio devices are used for

is much less than that of Wi fi and is also low power consuming device, thereby reducing interference and safety concerns. Moreover in this project poisoning where attackers inject corrupted data causing the loss or modification of original message sample, various cryptographic ciphers have been used. So we have also encrypted our database file before sending it to the client. The client can decrypt the file using the key. In another project 'A deadline driven epidemic data collection protocol suitable for tracking inter personnel rendezvous' we can see the application of Bluetooth for peer to peer wireless data collection algorithm.

In our project we have three components-ambulance which acts as the client, scanners which act as Bluetooth access points and master servers. When the ambulance sends signal to the scanner in order to get the database for finding the shortest path leading to the hospital, the scanner sends the database to the ambulance in an encrypted format. This similar approach is observed in another work 'In-Building Location using Bluetooth'. In this project the location of any mobile device can be detected using Bluetooth scanners. The received signal

strength from each coordinate is sent to the server by the scanners. The server has a map of RSSI (Received Signal Strength Indication) at different coordinates. Thus it gives the deduced location of the mobile device by the use of the received RSSI and triangulation technique.

III. METHODOLOGY

A: ADMINISTRATION:

1. FLOW DIAGRAM:

2. STEP ALGORITHMS:

Step 1: START

Step 2: Login window opens
　Enter user name: name
　Enter password: pass

Step 3: If username exist in table:
　　If password==pass:
　　　//login successful
　　　//Another window opens
　　　To enter new node GOTO Step 4
　　　To insert distance between two nodes GOTO Step 7
　　Else:
　　　//login unsuccessful
　　GOTO Step 2

//ENTER A NEW NODE

Step 4: click" ENTER NEW NODE" button in new window
　//another window opens
　GOTO Step 5

Step 5: Enter new node: node
　Enter X co-ordinate: x
　Enter Y co-ordinate: y
　Enter Z co-ordinate: z
　　　"Submit" button is pressed

Step 6:"ENTER ANOTHER NODE" button is pressed
　//to insert another node
　//another window opens
　GOTO Step 5

//INSERT DISTANCE BETWEEN NODES

Step 7:"enter distance between paths" button is pressed
　//another window opens
　GOTO Step 8

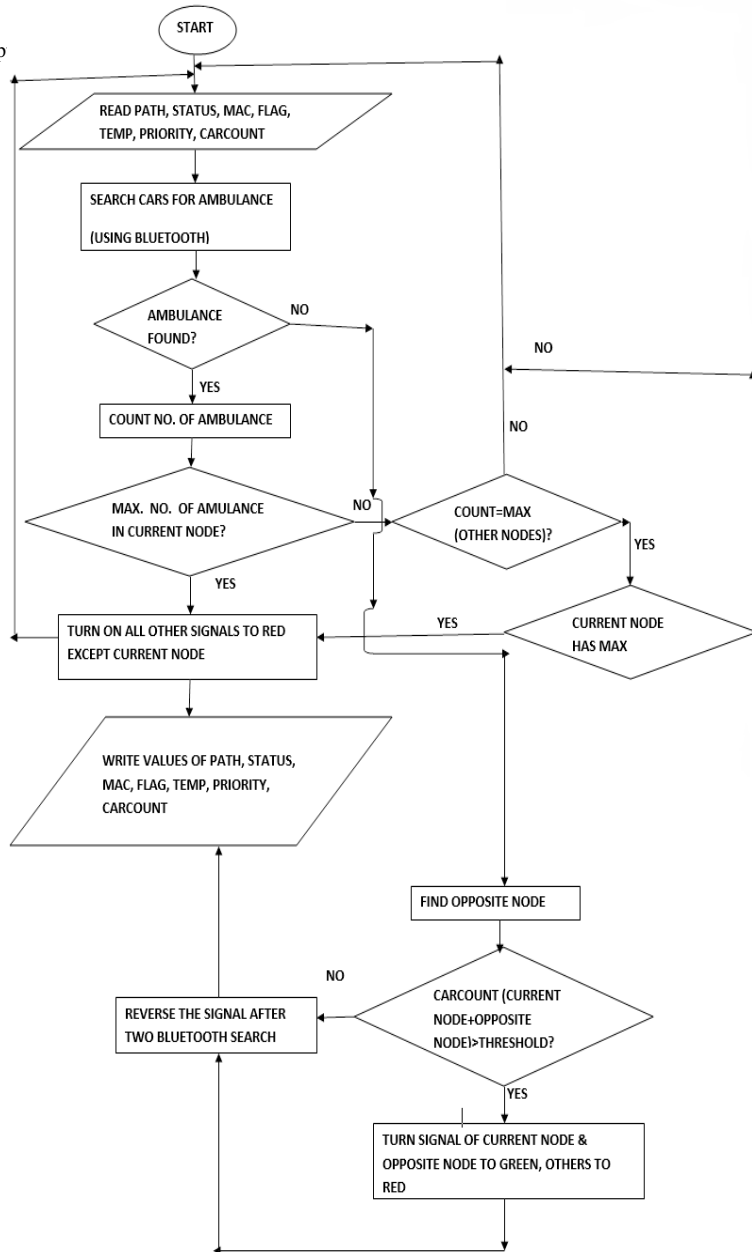**Step 8:**Enter source: source
　Enter destination: destination
　Enter distance: distance
　"Submit" button is pressed

Step 9:"ENTER ANOTHER DISTANCE" is pressed
　//to insert distance of other two nodes
　GOTO Step 8

B: AMBULANCE:

1. FLOW DIAGRAM:

2. STEP ALGORITHMS:

Step 1: START

Step 2: read path, status, mac, flag, temp, priority, car count from file

Step 3: search cars (Bluetooth devices) at a particular node

Step 4: if mac address of ambulance is found in search:
   GOTO Step 5
  Else:
   GOTO Step 13

Step 5: Count number of ambulance present in current node

Step 6: find number of ambulance present in every other nodes

Step 7: if maximum number of ambulance is present in current node:
   GOTO Step 8
  Else:
   GOTO Step 9

Step 8: Turn all node-signal RED except current node, which is turned GREEN
   GOTO Step 12

Step9: if number of ambulance present in current node is same as any other node and that is maximum value of ambulance in any node:
   GOTO Step 10
  Else:
   GOTO Step 2

Step 10: check priority of each node

Step 11: if priority of current node is maximum:
   GOTO Step 8
   Else:
    GOTO Step 2

Step 12: write updated values of path, status, mac, flag, temp, carcount into file
   GOTO Step 2

Step 13: find opposite node of current node

Step 14: check if sum of carcount of current node and opposite node is greater than threshold
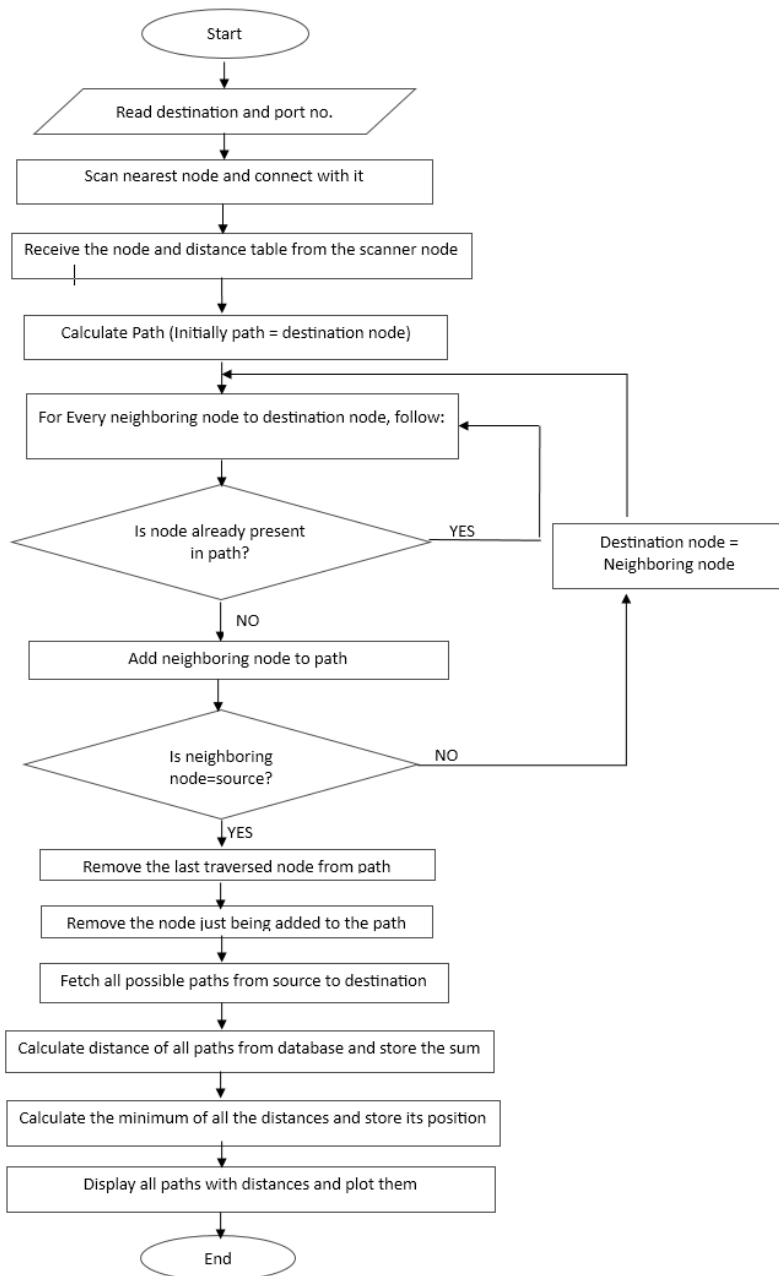   Value then:
    GOTO Step 15
   Else:
    GOTO Step 16

Step 15: turn on current node and opposite node-signal to GREEN and others to RED
   GOTO Step 12

Step 16: reverse node-signal of each node after 2 bluetooth search time (1 bluetooth search time
   requires approximately 8 seconds)
   GOTO Step 12

C:PROCEDURE PATH:

1. FLOW DIAGRAM:

2. STEP ALGORITHMS:

Step 1: Start.

Step 2: Read the destination and the port number through which you want to communicate.

Step 3: Scan the nearest node/traffic signal scanner.
Step 4: Connect to the node scanner with the chosen port number, and send it a message.

Step 5: Receive the node and distance tables (database) in encrypted form from the scanner node, along with the name of the scanner.

Step 6: Decrypt the tables to get the actual values.

Step 7: Calculate the path using the procedure Calculate Path

(source node name, destination node name and path). Initially variable path contains the destination node.

//PROCEDURE CALCULATE PATH:

Step 8: For every neighboring node to the current destination node, carry out the following steps.

Step 9: If this node is already present in the path:
   Go to step 8 and continue execution with the next value.
   Else:
   Go to step 10.

Step 10: Add the neighboring node to the path.

Step 11: If this neighboring node is the source:
   Go to step 12.
   Else:
      Go to step 15.

Step 12: Store the path.

Step 13: From the path, remove the last node traversed.

Step 14: Go to step 8.

Step 15: Go to procedure CALCULATE PATH with only the destination node parameter being replaced by the neighboring node.

Step 16: Remove the node just being added to the path.

Step 17: Return from the procedure CALCULATE PATH, fetching all the paths possible to go from the source to the destination.

Step 18: For all paths obtained between the source and the destination through the above procedure, calculate their respective distances with the help of the database.

Step 19: Store these distances in a list for later usage.

Step 20: Calculate the minimum distance of all the distance of the paths and store its position.

Step 21: Display all the paths, along with its distances in the window, where the paths are searched.
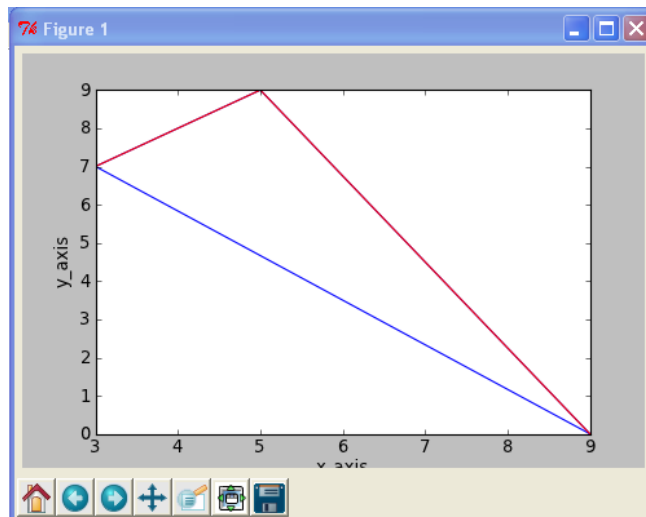
Step 22: Using the modules matplotlib (pyplot) and visual, plot the two dimensional and three dimensional views of the paths with respect to the co-ordinates of the nodes obtained from the database. The minimum distance path is differentiated by coloring it red while the rest are blue.
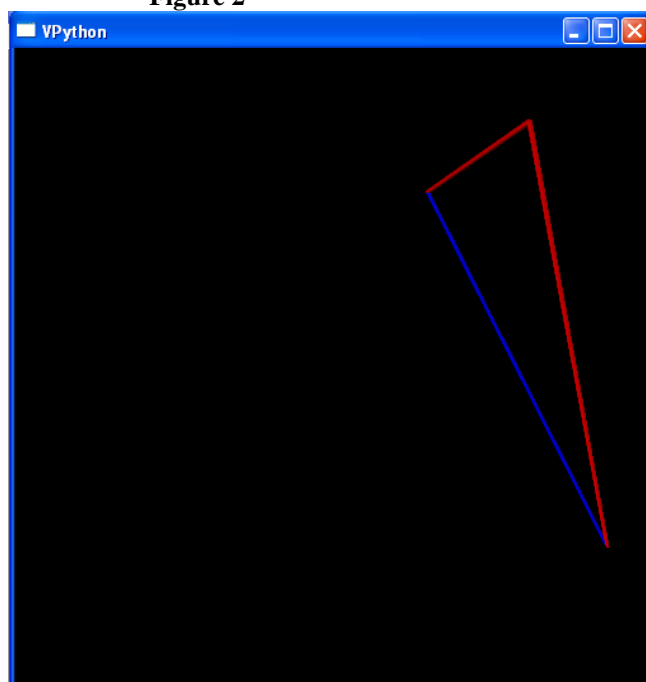
Step 23: End.

IV.   RESULTS
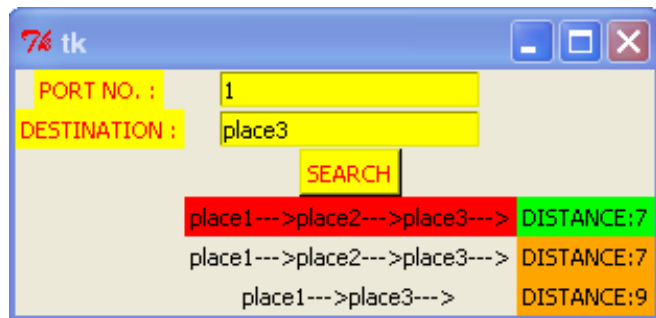
Figure 1

Figure 2

Figure 3

Figure 1:shows every possible path with distance aong with the shortest path separetely

Figure 2:shows every paths along with shortest path in 2D plot

Figure 3:shows every path along with shortest path in 3D plot

V.   FUTURE WORK

Our project can be enhanced by working in the following area,

- Encryption

- Tracking of vehicles

- Generalizing the ambulance concept

- Stoppage time

1. Encryption: We can increase the level of security of our system by making the encryption key even more

secure because only the secrecy of the key provides security and it's better to assume that the intruder knows the system. We can make the system even more secure by encoding the encryption key. We can do it by using a separate key(second level key) to encrypt the basic encryption key. Hence to decrypt the file containing the information we have first decrypt the basic key using second level key and then decrypt the file using the decrypted basic key. This is known as second level encryption-decryption. Similarly we can increase the level of encryption-decryption by increasing the number of keys, each key, barring the final key, is encrypted.

If we use AES instead of DES it will enhance the level of security of the system. We can also increase the size of the key from 128 to 256 bits but it will require higher hardware configuration which in turn increases the cost of the project.

2. Tracking of vehicles: we can track any vehicle as every vehicle will have an inbuilt Bluetooth device having unique MAC id. The Bluetooth scanners installed in the traffic signals will monitor the vehicle and the vehicle's path can be derived by fetching the time and the position of the bluetooth scanners which are scanning the vehicle. Hence, we can derive the path of the vehicle by comparing the scanning time of the different Bluetooth scanners.

3. Generalizing the ambulance concept: In our project the system give special preference to ambulance, where the signal allows it's smooth mobility, blocking other signals. This concept can also be applied to fire engines and for the vehicles of VVIP's. The work load of traffic police is substantially reduced, thereby, less number of traffic police can be deployed.

4. Stoppage time: We often encounter road blocks during maintenance, special occasions, procession etc. To avoid this kind of trouble we can introduce a new concept of "stoppage time", which is the time difference between the actual time and the ideal time taken by a vehicle to cover a certain path. We can incorporate this stoppage time concept along with the shortage path algorithm to find the real time optimal path.

VI. CONCLUSION

From a proper analysis of positive points and constraints of the system it is inferred that the system is working as per the objectives of the project. Installation and maintenance of the system is cost effective and takes less time. The system-user interface is user friendly and does not require specialized training or skills to operate it.
The project has been designed to substantially enhance the performance by ensuring smooth mobility of emergency services (like ambulance, fire engines, etc.). The system also reduces the workload of traffic personnel, as well as is of great help to the drivers with regard to the shortest among all possible routes between any two junctions.

Being an automated signaling system it eliminates the chances of human error which often results in road accidents and mishaps.

As discussed earlier, this project transforms the shortcomings (in terms of range and scanning time) of Bluetooth Technology into its strength thereby consolidating its applicability.
Thus this project is practically feasible, economically viable, and reliable in nature. Summing up we can say that this project with its ready to apply technology, invariably finds its application in our traffic signaling system.
An improvisation of the project and subsequent modification of the system can serve our purpose as and when needed in near future.

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