

Design and Implementation of V2V and V2I Communication Systems using ML based Li-Fi technology

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Research Article

Keywords: Light Emitting Diodes(LED), Li-Fi, wireless communications, vehicle to vehicle(V2V), vehicle to Infrastructure(V2I)

Posted Date: April 6th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-371588/v1>

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Abstract

These days population are taking a risk in their drive and in no time dangers are happening, and losing lives by doing tiny wrongs when on drive near restricted zones. To escape these accidents to make population risk free traffic department are introducing signboards. But then again with the ignorance of the people, dangers are happening again, so “Li-Fi technology” is being used here to decrease the count of accidents. The transmission takes place with the help of LEDs (Light Emitting Diodes). Text, audio and video can also be transmitted with the help of this li-fi. The transmission is done when the light turns on and off. When this is compared to Wi-Fi it has many advantages like this light is not harmful to human body. The Transmission takes place in the form of zeroes and ones. Therefore to avoid accidents we suggested an intelligent, adaptable, and efficient model that utilizes Machine Learning techniques. The proposed system helps in vehicle to vehicle and vehicle to Infrastructure communication systems.

1. Introduction

Past years when there was no light people felt difficulty in life and after that a man called Thomas Alva Edison evented an electric lamp with carbon filament in 1879 and here was the first light bulb came into our lives and after that there are so many of light systems in and around the world. Though Edison invented the bulb, so many scientists did their best developing some other ways of implementation of light like using code to give data to the customer and with his invention of the photo phone, a device that covert a voice signal on a goof beam of light[1].

Later on ,discovery “LED” is very good and came into a great existence and all people are making everything good and helps a good cause to the people and evening people also accepted these upgrading towards the light and light also came in a wider way and some other also invented how to transfer data through the light so we can send the data transfer using light because light is the fast medium which can be transmitted in a higher in speed and having a good type of medium and upgrading everything in the world is important like same way of implementing light to transfer faster and fastest and there are so many industries that allow light to a greater extent and passes light in a good transfer and companies that are providing new capability of applications and situation that implemented to give the present world to a good ahead that heps our future and helps to develop and move forward in a good way to communicate present and future system and services application data and end users[2]-[5].

1.1 Li-Fi:

Li-Fi has great speed and its network is 2 directional. Using light-weight knowledge is communicated. Li-Fi is clusters and this gives OWC and this also have many colours systems beside actinic ray. Still, Li-Fi is irreplaceable, during this same source of illumination is used for enlightenment and additionally used for communication[6].

1.2. working principle:

Li-Fi, by modulating the intensity of sunshine knowledge to be transmitted. The modulation that is made cannot be visible to the eyes. Li-Fi can work inside, outside when all the lights are dim and in the visible. Pure Li-Fi's additionally light-emitting diode unsure which suggests it works with several ready-made LED's. The Li-Fi operating is easy however dominant. When the current which is uncompromised will be used to the light diode and the photons that are also uncompromised is visible in the radiance. These diodes are semiconductor devices, it advises that the illumination should be controlled at high speeds that will be noticed by photo detector. Victimization allows for speed data which may be conveyed from the light diodes. Radio circuits are to be used for Radio frequency communication and receivers are much complicated. The Li-Fi are not very much complex and the modulation can be used directly in the communication devices. Human race has been victimization light-weight as a medium for communication and lightweight is that the helpful issue during this field. When the invention of sunshine bulb by Thomas Alva inventor, the methods are new which establishes the create use of weight during a totally different manner for communication. A scientist from German Herald Hass developed transfer of data by use of light-weight fidelity. The invention are going to be replaced for Wi-Fi, the knowledge transferred at vary 500Mbps[7]. This instrumentation practices every kind of spectrum same as white light-weight, infrared. The Li-Fi isn't stopped to light-emitting diode or optical device or to specific obtaining system. The road accidents are more due to the over speed of the vehicles and rash driving in public. Most of the drivers will drive the vehicle at very high speeds will not bother about the public in the restricted areas. They will not suppose the traffic police, then have a tendency to cannot come through full response from them. Additionally, it's unacceptable to watch those areas in the slightest degree time to manage their speed analysis on totally and part machine-driven road systems is being conducted in most developed countries. The key technologies are unlikely to be introduced before the top of the century and a few are unlikely to be enforced inside 20 years. These systems provide wonderful opportunities to regulate vehicle speeds and movements so as to avoid accidents however they trust, of course, on refined options designed into the road and vehicle. Progress with these systems ought to be monitored however they're unlikely to supply any important short-term solutions. However varied varieties of accident are occurred on categorical main road, main road, off road simply because of little unsure activities. Rash driving, system failure, collision because of obstacles, exiting speed management[8]. It is mostly based on VLC and it can be easy in the process of the making a light as a media great way of communication by low cost implementation like no need use of the cable wire communication. Li-Fi is evolve to a fast way of transmitting data which the rate speed in Wi-Fi, while using Li-Fi the rate of the performance or speed can reach to less than or equal to 14 Gbps. This an introduction of the Li-Fi technology including the architect and process, modulated, performance, and the challenges. The result of it can be made that it is used for the position and information to develop and improve some of the Light technology. The Li-Fi is 100 times faster than Wi-Fi and for more safety Li-Fi life is more secure communication than Wi-Fi efficiency and safety is more in light fidelity[9]-[13].

Li-Fi is the new and are the modern technologies in communication to focus and to improve the current situation in technology by makes useful of VLC opposed to the radio waves like transmitted waves used by Wi-Fi. And this speed also increases more in the light than the network we use and more can be

implemented in any ways that has two qualifying components and those are visible light communication this helps to see the data that is communicated along all the way all can see this type of spectrum and these days the network is also transmitted data through a high cable data type called as fiber optic cable which transfers a more amount of data and it does not lose data and helps the user to use of all the data and as well as this possible and light is also transmitted along this way of communicating towards the vehicles and helps us to improve all the great texture towards the world and helps everyone to the greater way of and this way of implementation and be transfer a high amount of packets for any type of purpose that are gone of accidents and through this we are going to save as many lives as possible and Li-Fi is the best way to save the lives and I mean like helps us in a better way in this fast-growing world[14]-[16].

The VLC source of illumination which might be a decent kind like of a fluorescent of the bulb or a lightweight and the data transfer of the diode. diode light-weight bulbs are unit the foremost optimistic VLC light-weight manufacturing supply, however about the robust of the diode is a robust and healthy Li-Fi system considers an extraordinarily larger and high rates of sunshine output. Fluorescent produces the light-weight in an exceedingly a lot of larger and wider bands of wavelengths, that makes it a way comparatively less potency source of illumination than diode. LED, on the opposite hand, could be a source of illumination that emits light-weight in a very slim band of waves of the lengths, creating it an additional economical of illumination[17, 18].

Light is additionally a conductor, which means that it will amplify the power of a candle and switch speedily. this can be a very important and best way quality to appear for in an exceedingly to the source of illumination as a result of Li-Fi takes over a constant stream of photons produced as actinic radiation for the transmit of information.

2. System Design

The Li-Fi has basically 2 parts, "Transmitter" and "Receiver". diode lightweight is employed as signal supply between 2 finish systems. knowledge is transferred through changed signal to the diode. Microchip changes data around these transmitter and receiver ends properly. The half of the part changes the data with a defined part of time and transmits the into within the binary data of one's and zero's implementing a diode light bulb. This one's and zero's are the output of light which means that 1 is for on and is off of the light.

The other part after transmitter attracts these blazes using a light diode. This is be used for transferring or for passing the signals through the light. It is capable for passing signal at good speed. In this system we have transmitter part and the receiver the receiver part and adapted at the vehicles and the transmitter is fixed at traffic sign board. LED is used as a great signal about the source.

3. Experimental Results

This diagram illustrates the transmitter module and during this model Li-Fi was transmitted to the electrical device, what is more the Arduino and transmitter is connected to the various connections were done at the same time. In addition to the representing diagram of receiver, electrical device is employed because the emitting portion and a few elements like buzzer and motor directly connected to driver circuit and also the accommodative light-weight system is performed through the junction rectifier by victimization LDR and motor indicates the speed of automobile engine.

The Li-Fi system consists of basically 2 system that, "Transmitter" and then the "Receiver". diode lightweight is employed as signal supply between 2 finish systems. knowledge is transferred by the modulated signal to the diode. The microchip (MPU) system modulates and demodulates data around these transmitter and receiver ends properly.

The transmitter half modulates the sign with the desired fundamental measure then conveys the information within type of '1's and 0's' employing light-emitting diode bulb. These are nothing however the changes the flashes that are in the bulbs. The receiver half clips to employing a photodiode and enlarges to output in which the signal is present. Li-Fi is enforced exploitation emitting diode light-weight bulbs at downlink transmitter.

For transmission the information from transmitter to the receiver the information ought to be reborn from electrical signals to optical signals so as to transmit. By light-emitting diode the optical signals are transmitted we have a affinity of the high voltage to the low voltage in the particular stage. when amplify the signals in transmitter the sole knowledge can get transmit to receiver.

After giving {the knowledge the info the information} to the microcontroller the information gets modulated within the type bits like 1's and 0's and therefore the data is transfer through light-emitting diode. in order that at bit one is light-emitting diode can get ON at bit zero the light-emitting diode can get OFF we have a tendency to can't notice the sunshine is on or off it'll happens within the fraction of seconds. Here we have a tendency to are giving knowledge manually during this project we have a tendency to four switches for each switch we've completely different knowledge like some places like "SCHOOL ", "HOSPITAL ZONE", "SPEED BREAKER" by pressing in every switch we will transmit completely different knowledge that is received by the receiver and show on automotive screen. Here we have a tendency to use batteries(or) current for power provide.

3.1 Proposed ML Algorithm

The calculation that we are utilizing is Logistic Regression. Let us examine the fundamental ideas of Logistic Regression in subtleties and realize what sort of issues would it be able to support us to tackle. The calculated capacity, additionally describes as the capacity of sigmoid that was created by huge analysis so as to depict features of popularity developing in the environment, increasing rapidly. It is a Stormed incline that is used to take any legitimated esteemed number hence guiding it in a transformation somewhere that is in the possibility of 0 and 1, however never precisely at these limits. $\frac{1}{1 + e^{-value}}$. The utilized condition helpful in the Logistic relapse shows the portraying, basically the

relapse of straight type. Here, input esteems (x) are consolidated straight using coefficients esteems or loads in order to anticipate a esteem to be yielded. The important contrast that is inferred from relapse of direct type is that instead of numerical qualities the yield esteem being demonstrated is a double quality (0 or 1). Given below is a model that's calculated relapse condition is:

$$y = e^{(a_0 + a_1 \cdot x)} / (1 + e^{(a_0 + a_1 \cdot x)})$$

Here y is the anticipated yield, a1 used for the single information esteem (x) coefficient mapping. Each and every block in our prior information usually have a mapped to the coefficient of b that needs to be inferred from our preparation information and also the a0 is the predisposition or block term.

3.2 Logistic Regression is used to Predict Probabilities

Usually the likelihood of the class that is default is demonstrated by Logistic regression.(e.g. the first class). For instance, on the off chance that we are demonstrating individuals' sex as female or male from their stature, at that point the top of the line could be male and the calculated relapse model could be composed as male likelihood of a given an individual's stature, or all the more officially: Prob. (sex = male | height) Written as an alternate manner, we can demonstrate the possible likelihood that the info (X) of the default type class (Y = 1), can be composed officially as below: $P(X) = P(Y = 1 | X)$ Notice that the likelihood expectation ought to be rebuilt into a paired worth so as to really make a likelihood expectation. Also, on this later when we talk about creation forecasts. Calculated relapse is a straight technique; however, the forecasts are redesigned utilizing the strategic capacity. The effect of which is regularly that the forecasts can no longer be seen as a straight blend with contributions as it can be seen with straight relapse. We do not have the plunge in the science an over the top measure of, anyway we are ready to turn the above condition as follows: $\ln(p(X)/1 - p(X)) = a_0 + a_1 \cdot X$ It is beneficial as we can notice that the count of yields on the best possible can straight too (simply as direct relapse), also in this manner the given information to the left side might be a logarithmic value of opportunity with the common class. The proportion to left is termed as chances of default classes. Chances are determined, the likelihood of the occasion partitioned with the likelihood of occasion, for example $0.7 / (1-0.7)$ having the chance of 4. Hence, we can rather compose: $\ln(\text{odd}) = a_0 + a_1 \cdot X$ As chances are redesigned logarithmically, generally we may call the left sided of log-chances and then again, the probity. The feasibility is to utilize another sort of capacities to redesign. With out of degrees, yet the entirely expected for alluding the change for relating of the straight relapse condition for the probability of the connection work, for example the probity interface work. The entirety always encourages to comprehend the model that is blended as the direct input, yet the direct blend identifies with the log-chances from the default class.

3.3 Logistic Regression: Prediction making

Forecast making and a calculated model of relapse is straightforward in stopping as numbers in the relapse with strategic condition and to figure out a result. We can make a concrete of a particular late model. Considering a model we can foresee if an individual is female or male dependent on the stature. Having a stature with 160 cm can be the individual either female or may be male. Having taken the initials of $a_0 = -150$ what's more, $a_1 = 0.6$. Utilizing condition, computing likelihood of the male provided a

tallness of 160 cm and the used officially Prob (male height = 160). It can be utilized that EXP (), since it is the thing that one can utilize in the event that this model can be used into a spread sheet:

$$y = \frac{e^{(b_0 + b_1 X)}}{1 + e^{(b_0 + b_1 X)}} \quad y = \frac{\exp(-150 + 0.6 \cdot 150)}{1 + \text{EXP}(-100 + 0.6 \cdot X)} \quad y = 0.0000453978687$$

Again, the likelihood that individual is a male closest to zero. By and by it can be utilized that probability straightforwardly. Since it is an arrangement and a fresh answer is required, the probabilities can be snapped to a paired class esteem, as an instance: 0 if $p(\text{male}) < 0.5$ 1 if $p(\text{male}) \geq 0.5$ Since we realize how to make expectations utilizing strategic relapse, how about we take a gander at how we can set up our information to take full advantage of the procedure.

3.4 Logistic Regression significance for utilizing

An alternate technique has been proposed to identify phishing sites by utilizing strategic relapse as the grouping calculation with the assistance of exactness. The presentation measurements alongside our writing overview additionally demonstrated the precision level of calculated relapse to be the most elevated around 95 rate Thus strategic relapse were picked for characterization which performs better when contrasted with the Decision Tree calculation. Calculated Regression has a precision of around 96 to 97 rate and furthermore the time has come sparing when contrasted with Decision Tree calculation. Choice Tree calculation takes up a period over 5 minutes to result the yield while in Logistic relapse it as it were taking not many seconds. The mixes of highlights with respect to exactness, accuracy, review and so forth were utilized. Tentatively effective procedures in distinguishing different zones were summed up. Along these lines it tends to be summed up that better calculation is picked and the tentatively effective procedure in identifying phishing site. As phishing sites expands step by step, a few highlights might be incorporated or supplanted with new ones to distinguish them.

Simulated Results

Figure 3. Simulated Results of Video Transmission

The Receiver module helps to generate light through the LED and the LED and motor are connected to the driver circuit and driver circuit which allows smooth flow of the current and some general purpose boards are used in this receiver parts and these boards are used to establish a good amount of connection between the circuits and Arduino is that which helps to connect with all the components and generates the code using ide software which allows to sync the all components parts towards a greater extent and allows to run a smooth output. At receiver side we are using solar panel as photo diode. The LED transmits encode information which is received by the solar cell and data get demodulated. At receiver side also we have a micro controller, driver circuit and alarm unit. We have an amplifier at the receiver and photodetector which is a solar cell. The received signals are converted from the optical signals into electrical signals which is converted into the voltage.

The demodulated data given to the microcontroller and the data get displayed at the LCD. Here the microcontroller is used to give the information to the driver circuit and to the alarm unit. So that whenever any data is received by the receiver side by the microcontroller will operate the driver circuit so that the speed of the vehicles get decreases and also automatically alert the driver through the alarm unit

the output of the system is exhibited in the LCD and within instructions as per LCD the following actions will be done by the automobile: As automobile is in movement and when it detects the school zone a beep like sound occurs and automatically automobile reduces its speed and to decrease the occurrence of dangers. As automobile is in movement and when it detects the hospital zone a beep like sound occurs and automatically automobile reduces its speed in a manner to decrease existance of accidents which provides way to passersby As automobile is in movement and when it detects the Speed breaker a beep like sound occurs and automatically automobile reduces its speed in order to avoid jumps and to avoid accidents further.

Here we are giving 4 different inputs through transmitter which displays 4different outputs on the LCD at the receiver side according to switch is pressed here we are giving inputs manually but in real time we didn't have to because the data is already given to the ATMEGA328 to that particular zone so that the data will transmit continually through transmitter.

While pressing switch 1 we can see school zone is displayed on LCD for switch 2 it will display.

4. Conclusion

This work on video transmission using Li-fi is achieving excellent results. This sort of correspondence will likewise lessen the dangers of radiation risks and can be utilized anyplace, even at places where some electronic gadgets are prohibited because of the dread of radiation. As this is just a prototype, this can also be modified in many ways, albeit it gets expensive and the speed can also be increased. Unlike other transmissions, the advantage in this one is that the transmission is resumed from where it has left off rather than starting it over. This could be one of the greatest advantages of this because time won't be wasted in starting it from the first. In this prototype we were able to transmit a video from one PC to another PC with the help of some Arduino boards and cables. There is no risk for the human health and it needs just LED light to get transmitted. This would have a great future if taken forward. Here there is no chance of data to get leaked or hacked as there is no other source is used except light. So no other person can hack this. As this method is safer, quicker and secure, we are doing this. The system has been able to transfer a video from one device to another video successfully and further Automatic zone sensing saves the lives from accidents. In work, people ignore signaling and put their lives in risk. This thinking helps lots of people who work on roads. The auto dimming of headlights is useful for night travelers. Life is the precious and nothing can cost that in our life, so that we can save everyone in anytime. Accident are what changes lives and families and so to avoid that this is one of the important factors to save lives. The algorithm of classification analysis the performance based on the literature review is proof to give 97% accuracy. logistic regression is selected for the analysis which performs better when compared to the

Decision Tree algorithm. Logistic Regression has an accuracy of around 96 to 97 percentage and also it is time saving when compared to Decision Tree algorithm. Decision Tree algorithm takes up a time more than 5 minutes to result the output whereas in Logistic regression it only takes very few seconds. Thus, it can be summarized that better algorithm is chosen and the experimentally successful technique in decision making to prevent any accidents and other malfunctions .The proposed system helps in vehicle to vehicle and vehicle to Infrastructure communication systems.

Declarations

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Ethics declarations

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Author's contribution

C.T. Manimegalai - Idea , Experimenting & drafting

K.Kalimuthu – Software & Simulation

Sabitha Gauni - Article writing

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Figures

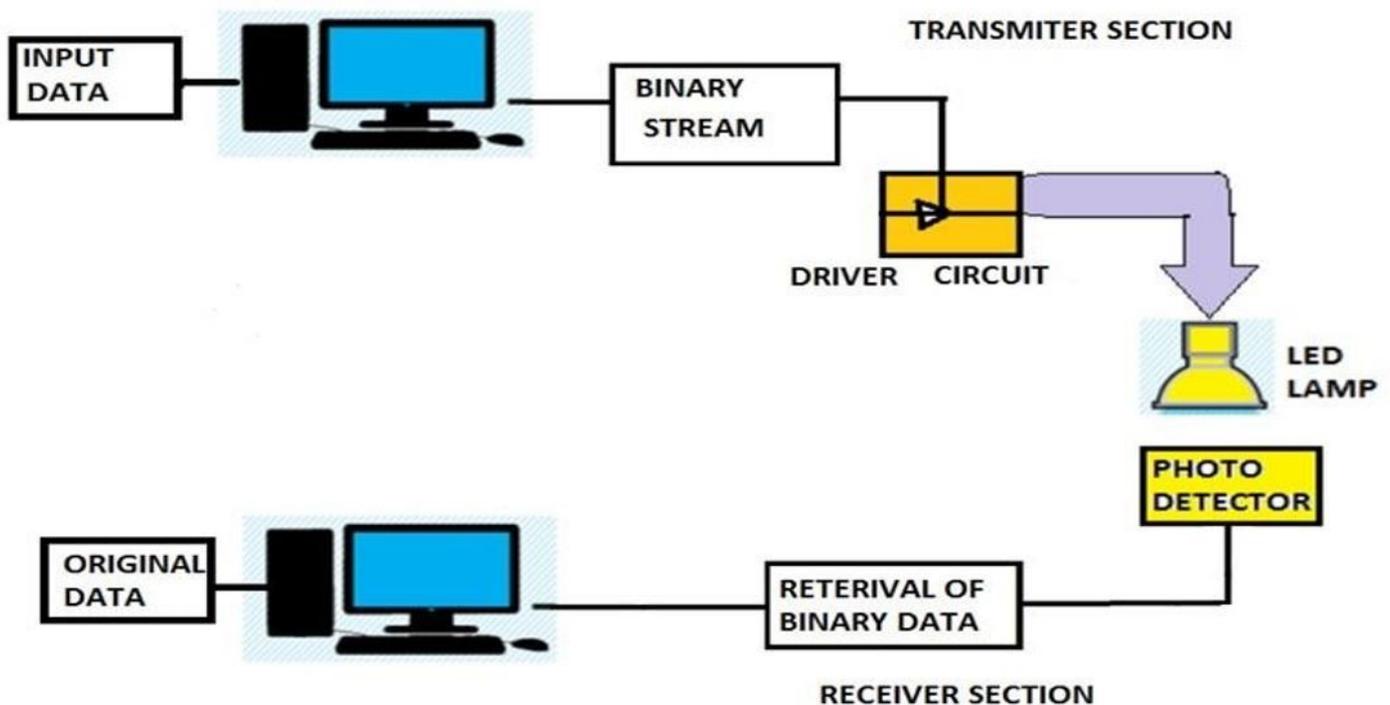


Figure 1

System Design

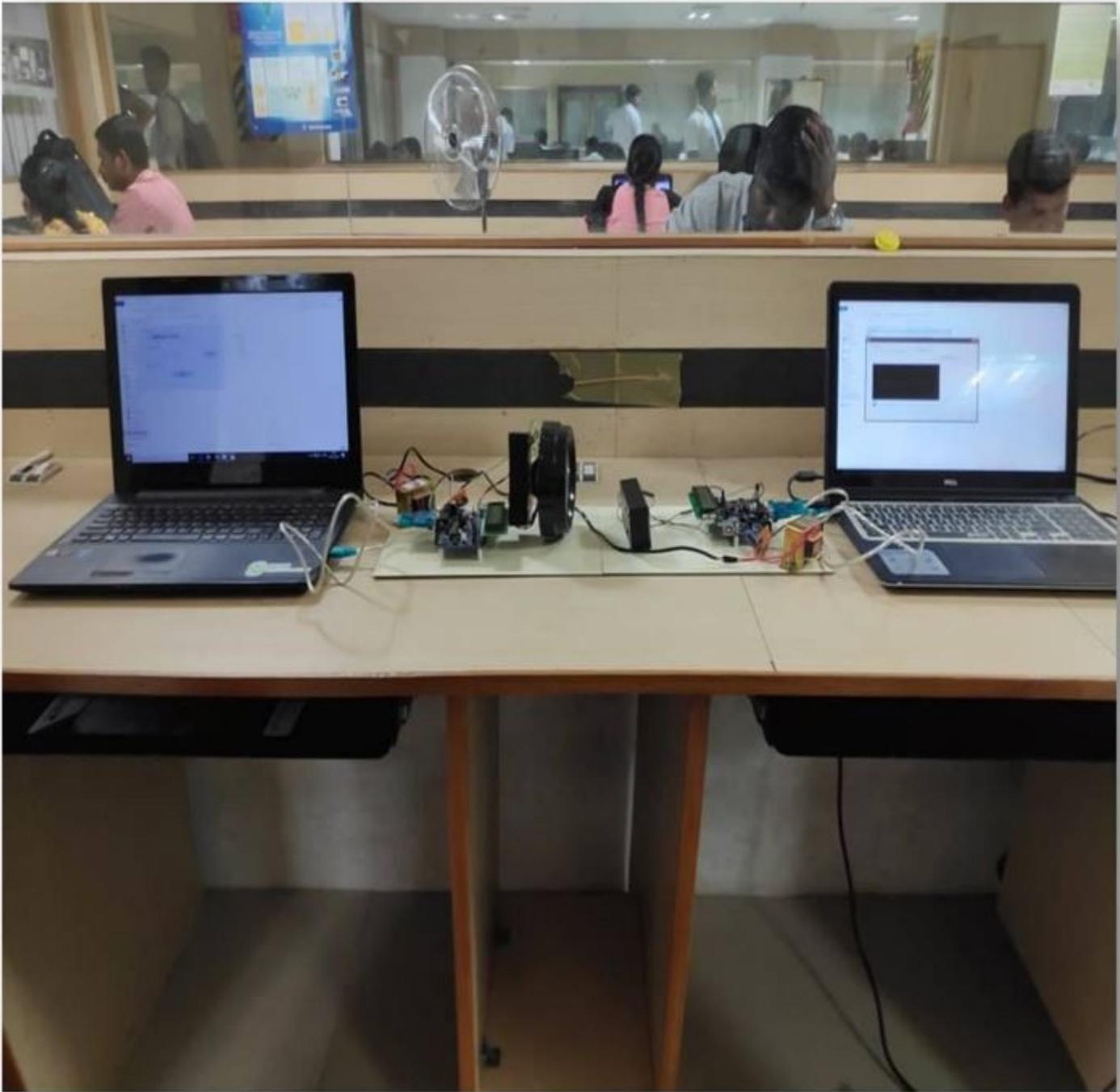


Figure 2

Experimental Setup

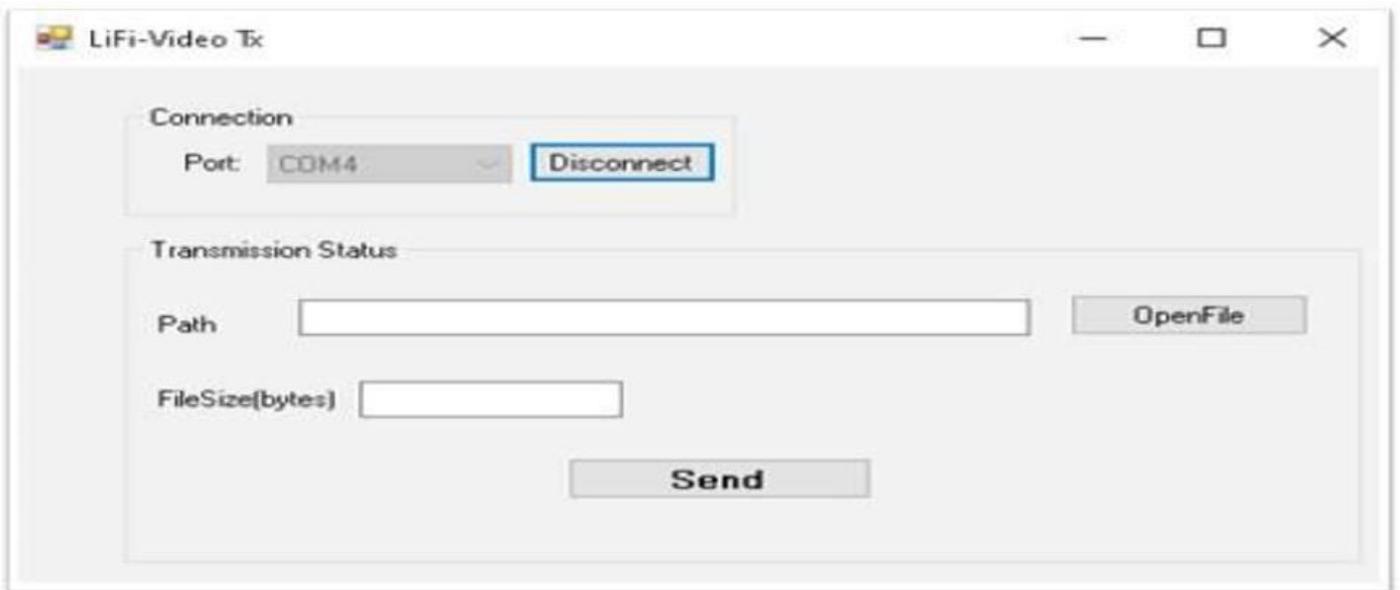
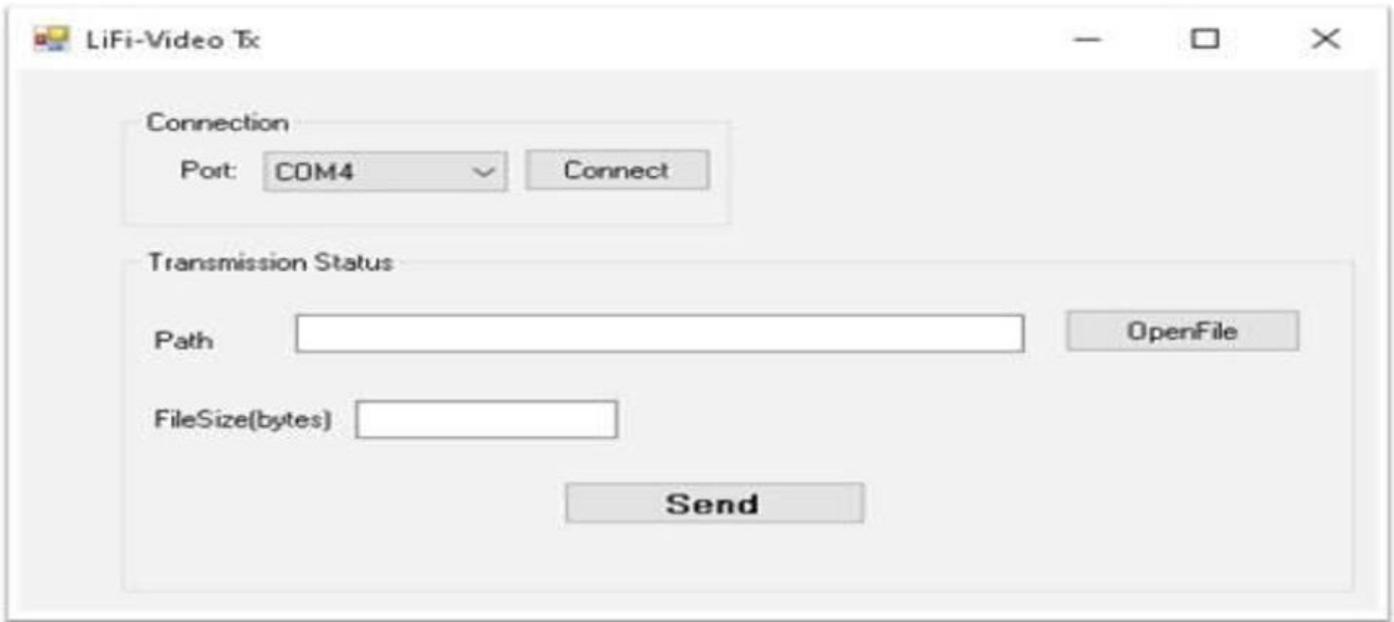


Figure 3

Simulated Results of Video Transmission



Figure 4

Experimental Results of Zone Identification

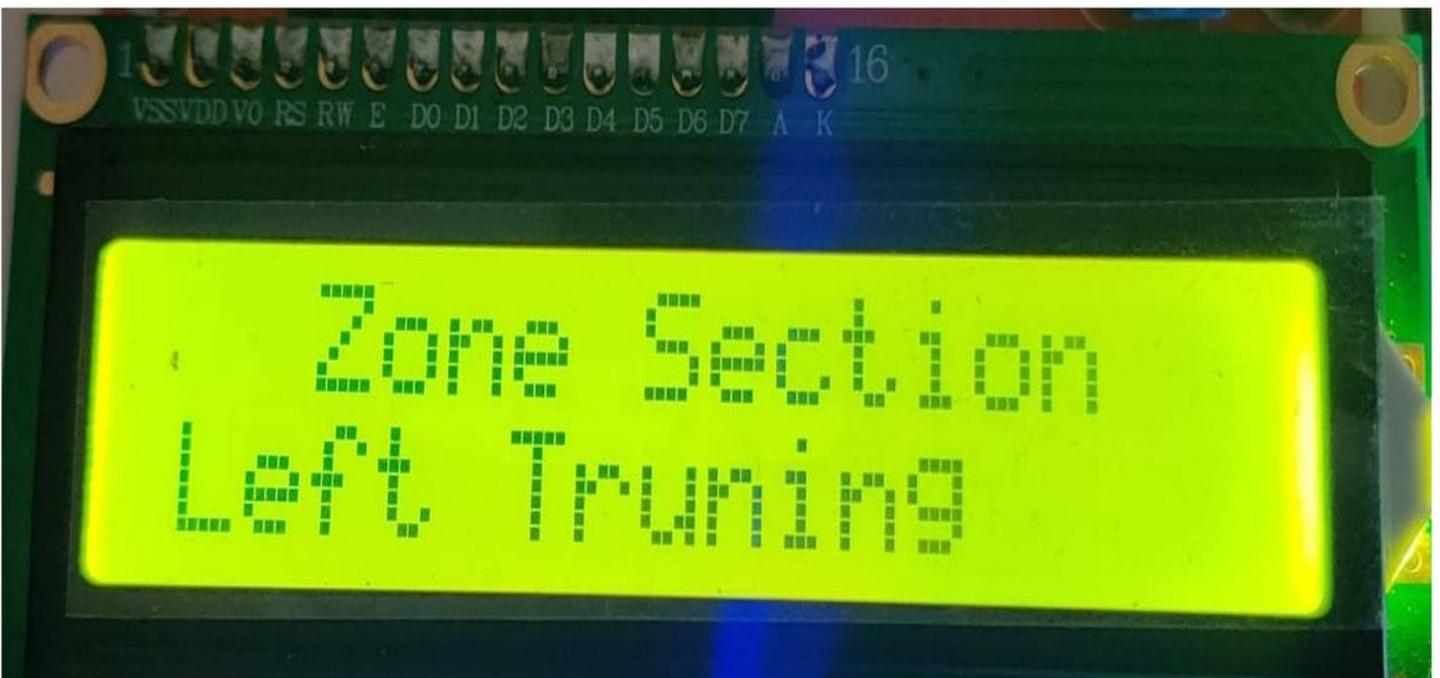


Figure 5

Experimental Results of decision making