LOCAL CONTENT BASED INTELLIGENT TRAFFIC CONTROL SYSTEM FOR SMART CITY

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ABSTRACT

Traffic congestion at intersections is commonly noticed whenever there is heavy traffic flow towards the intersection and usually results to delay which causes time wastage, fuel wastage and minor accident in some cases due to the violation of 'right of way' rules. Most of the available intelligent traffic systems are expensive for implementation and maintenance in this part of the world (Nigeria/ Africa as a whole). Several of the traffic control lights in Nigeria are mostly pre-timed (that is, they cannot respond to the dynamic nature of traffic). In view of these, low cost, local-based intelligent traffic lights control that suit Nigeria/Africa state of weather and environmental condition was designed and implemented for a particular situation (University of Ibadan Main entrance gate).

Keywords: Intelligent, Sensors, Infrared, Congestion

I. INTRODUCTION

Generally, traffic congestion at intersections is commonly noticed whenever there is heavy traffic flow towards the intersection. Effects of congestion are: delay which causes time wastage, fuel wastage due to high fuel consumption at stopping and starting of vehicle which leads to high fuel cost and congestion in some cases result to minor accident due to the violation of 'right of way' rules. In most developing countries vehicle traffic congestions are majorly being resolved either by human intervention or by traffic light system most of which are pre-timed which is not efficient enough for the ever-growing demands [1]. The optimization of the current transportation network is vital due to rise in traffic volume and the insufficient road network in dense-populated areas which leads to congestion on the road network and therefore results to wastes of time.

II. LITERATURE REVIEW

Over the years, this problem of congestion and rowdiness has been worked upon by implementing traffic light control systems which ranges from manual to auto-controlled systems [2]. The goal of traffic light is to ensure smooth and save traffic flow as much as possible and to protect the pedestrians (when crossing). Different traffic control systems have been employed to achieve this, spanning from simple pre-timed mechanisms to sophisticated computerized control/coordination systems which are adaptive to minimize delay experienced by the road users. Since most of this congestion commonly starts at the junction.

Intelligent Traffic Light also known as Intelligent Traffic control Systems (ICTS) is all about automating traffic signals based on the surrounding condition (real-time situation of the road). Intelligent traffic light control system is adaptive in nature (i.e. it is efficient and effective for every conditions) because; it has the ability to sense the road real-time conditions through sensors and take decision which result to traffic light cycle variation. There are two traffic light mode of operation i.e. Pre-timed and actuated mode of operation. The actuated is further divided into two fully actuated and semi-actuated. Vehicle detectors are used to sense the real-life traffic situation of a roadway. Several scholars had worked on the intelligent traffic control. Though every intelligent traffic control system is peculiar to a specific situation but with little modification it can be applied in several other likely situations.

According to [3], the vehicle detection system type employed in actuating traffic signal control is dependent on the requirements of the intersection, Controller needed, the construction and maintenance cost. More so, the placement of detectors also contributes to the operational efficiency of the traffic light at the intersection. [4] carried out related project considering the same junction (University of Ibadan main gate entrance).The author used period of the day as criteria to plan time allocation for different lane. The methodology involved three different plans (A, B, C) based on the past data. Plan A span from 06:00 – 10:00, while Plan B is from 10:00 – 14:00 and C from 14:00 – 18:00. They also developed an interface for user to interrupt the plan. Nevertheless, this is not intelligent because it does not react to the real-life situation of the traffic as no traffic situation can be accurately predicted and the involvement of Computer system causes the cost to be high as well as cost of maintenance.

VANET based IT system framework for smart city was proposed by [5]. The algorithm has ITL (Intelligent Traffic Lights) that gather information like traffic density, update the congestion information and report to the drivers. Nonetheless, this algorithm incurred cost on the vehicle owners as each vehicle must has GPS installed on-board which makes the algorithm non-cost effective. [6] proposed an ITCS which employed RFID, IR sensor help people to get information about traffic density in specific area and provide automated fine detection. However the overall cost of implementing this RFID is enormous.

[7] proposed an ITCS architecture which employed RFID vehicle tracking principle. The algorithm is a full automated traffic management system and provided an improved flow of traffic. [8] proposed a dynamic TCS which reduces the average waiting time of the vehicles meanwhile it does not consider other factors like priority for the most busy lane in an environment where some lane are busier than others. It is noteworthy that most of the employed system nowadays uses RFID which provide continuous monitoring of every car wherever they go meanwhile the implementation of this method is costly and it is debatable if vehicles monitoring is acceptable morally on the platform of civil right privacy.

III. METHODOLOGY

The schematic diagram and Circuit diagram of the proposed architecture are as shown in Fig. 1 and 2 respectively. The Low cost locally made Sensors were designed which detect the real time situation of the road and feed the

output into the input pins of the PIC16f877A which is then used to auto-reconfigured the traffic control cycle based on the input from the Sensor. Keypad is also provided in case of any emergency and for parameter update. This work employed Semi-actuated system for the case study (University of Ibadan) because; the traffic nature of the road conformed to the condition for implementing semi actuated system. The method involved the use of active infrared sensor for detection, PIC16f877A for control, 12V relay as switching device and traffic light module (rated 220V AC, 50Hz, and 1A).

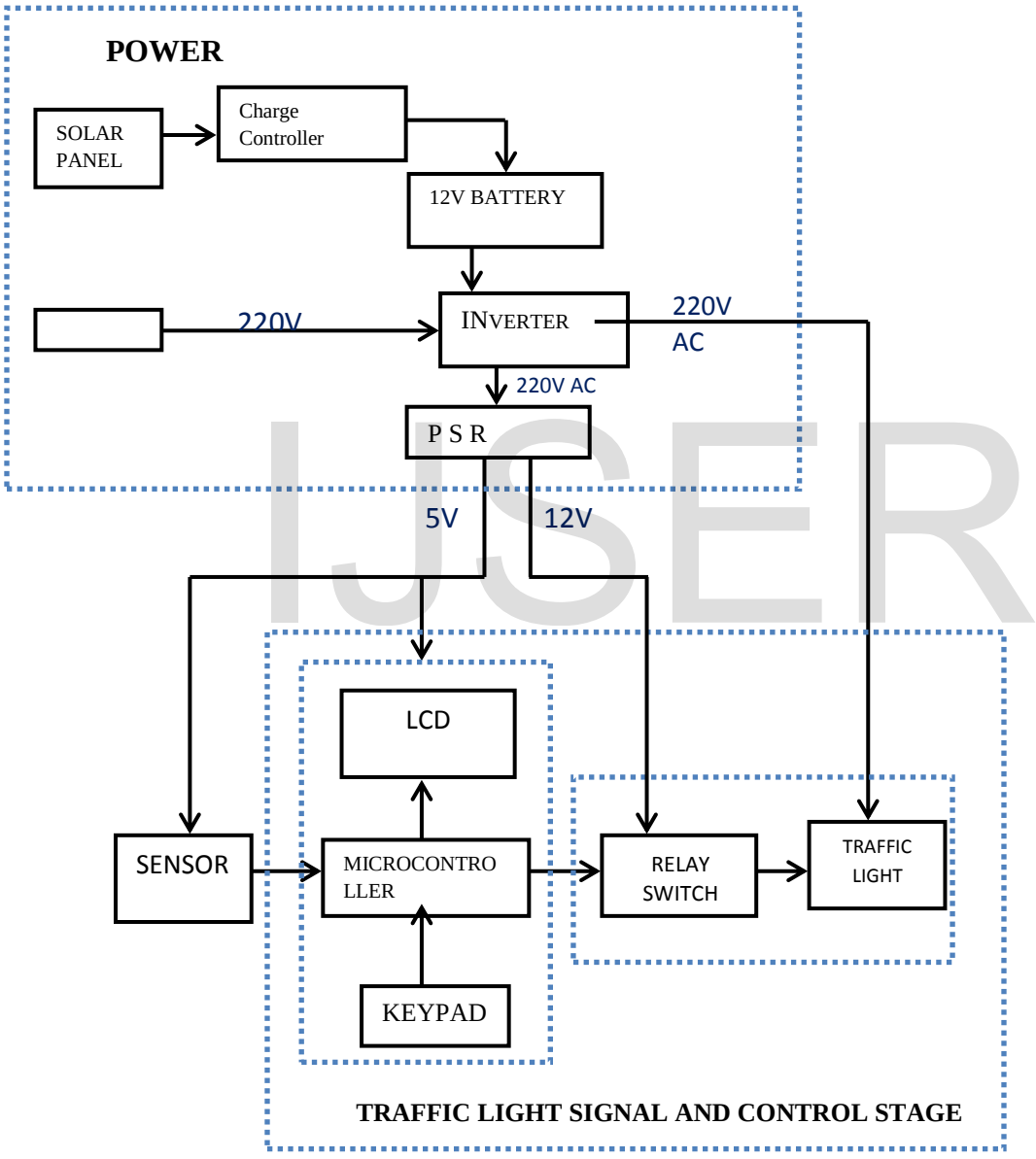


Fig.1. Schematic diagram of the Proposed Technique

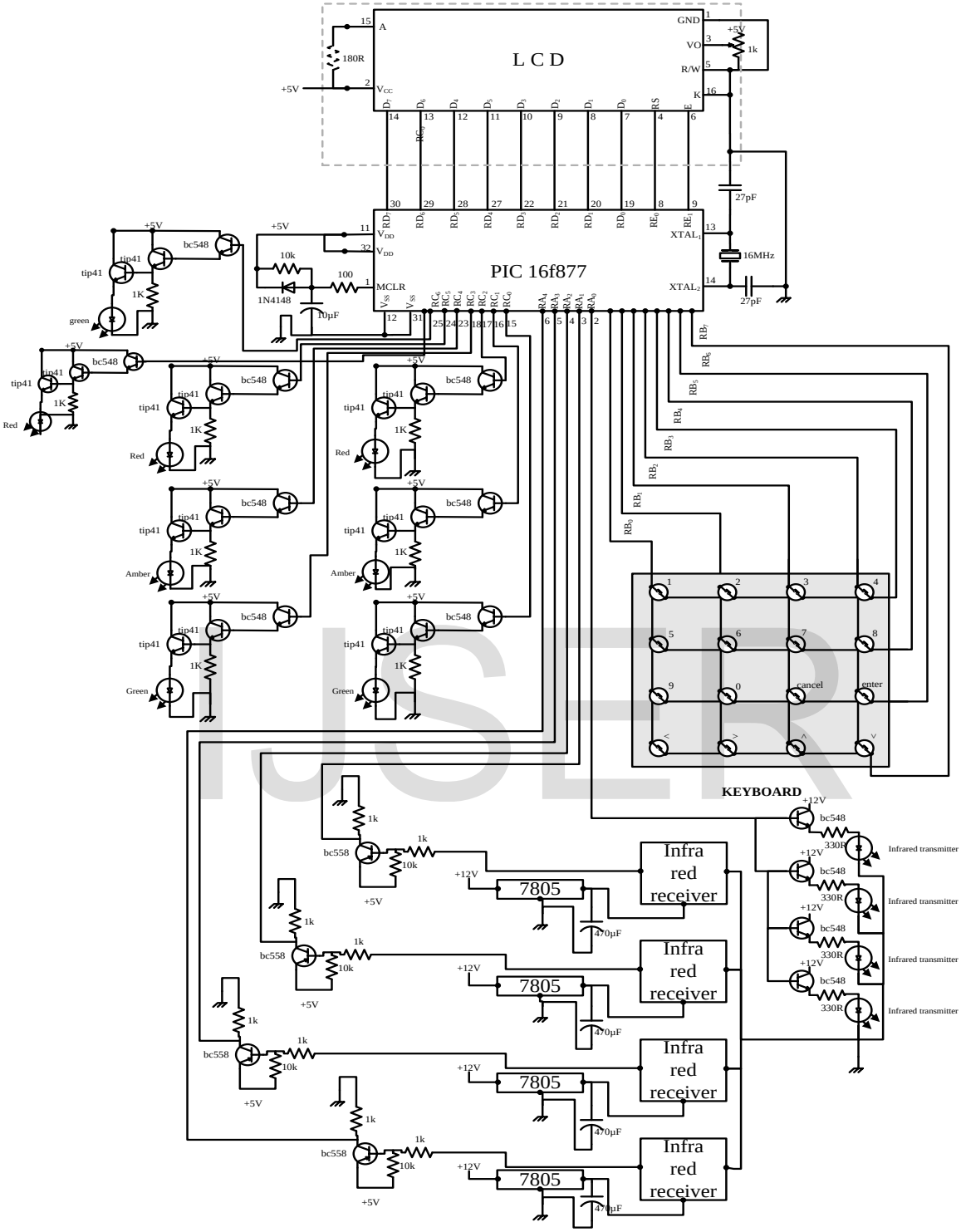


Fig. 2: Circuit Diagram Showing PIC, Keypad, LCD and their Interface

The low cost local sensor was designed and constructed using active infrared because of its cost, maintenance, installation and power requirement advantages over other sensors. The sensor circuit is as shown in Fig. 3.

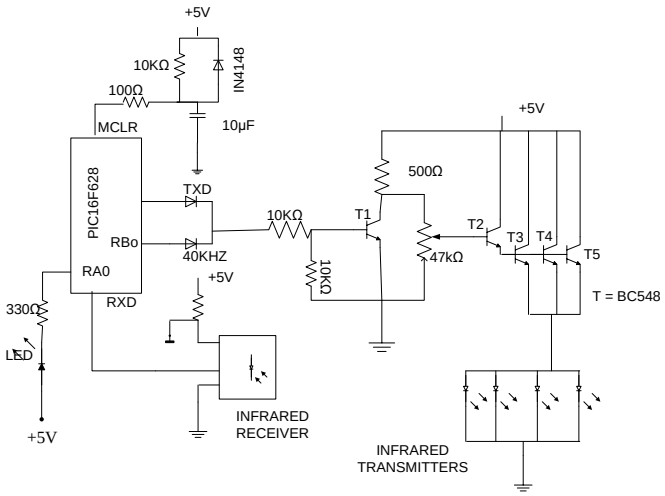


Fig.3: Sensor Circuit Diagram

The flowchart of the algorithm used in our case study (University of Ibadan Main Entrance) is as shown in fig 4.

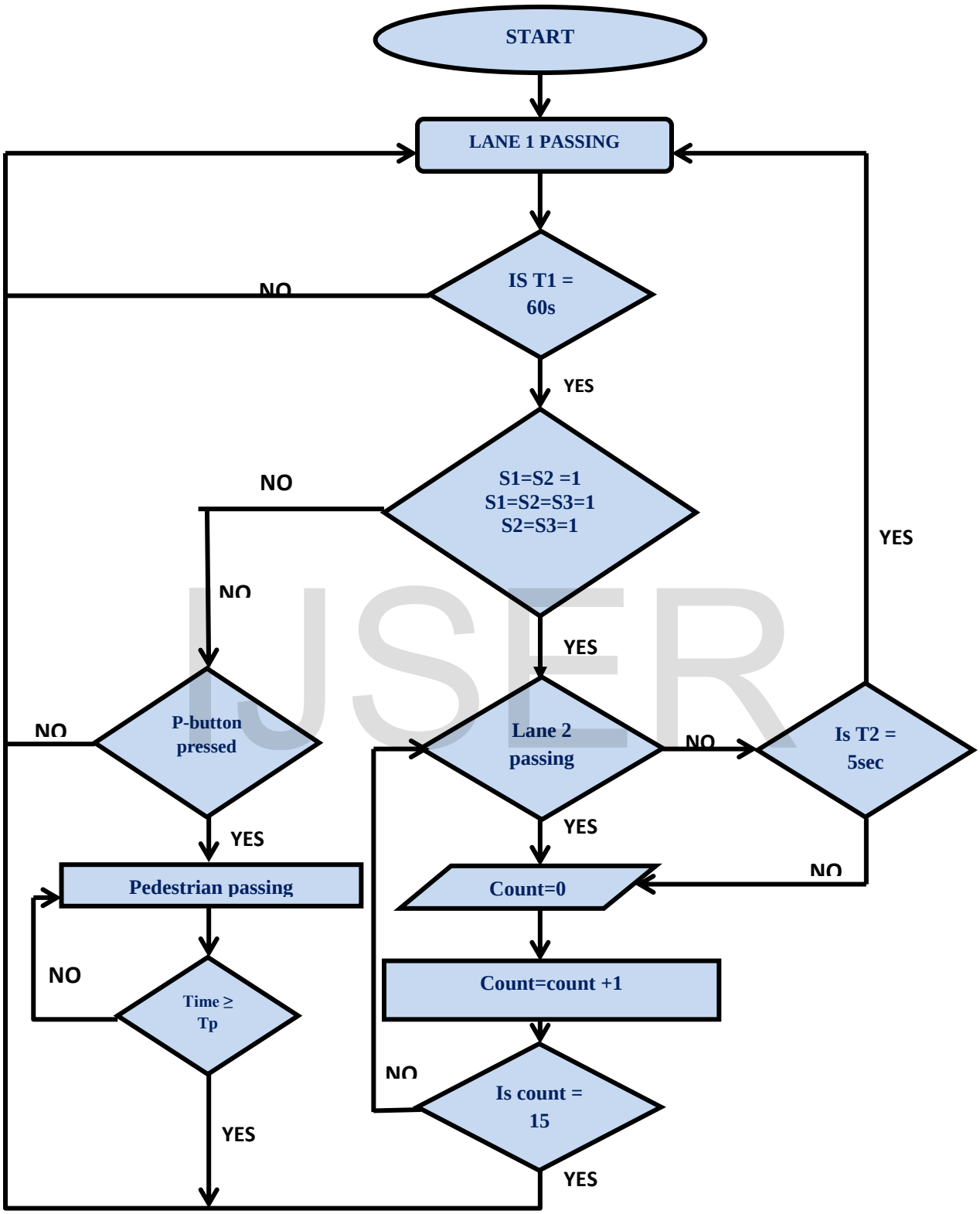


Fig. 4: Flowchart of the Project Algorithm

IV. RESULT

SENSOR TESTING

The sensors were built using 4-to-1 transmitters-receiver to maximize the signal received by the receiver and was built around variable resistor to vary the transmitter gain which in-turn varies the wavelength. The transmitting signal was checked to be sure that it is the same as the desired data using mobile Oscilloscope.

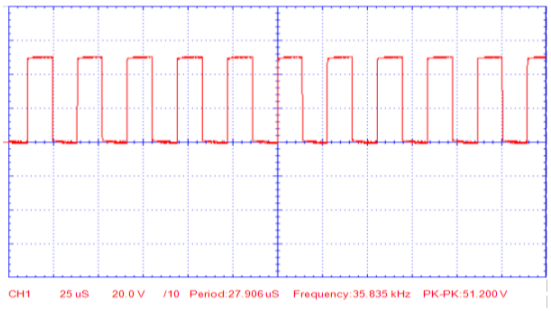


Fig. 5: Carrier signal waveform

The carrier signal was taken from the pin 6 of the PIC16f628 as shown in Fig. 5. It can be observed that the carrier frequency is 40 KHz.

f = 1/T = 1/25E-6 = 40 KHz (as desired)

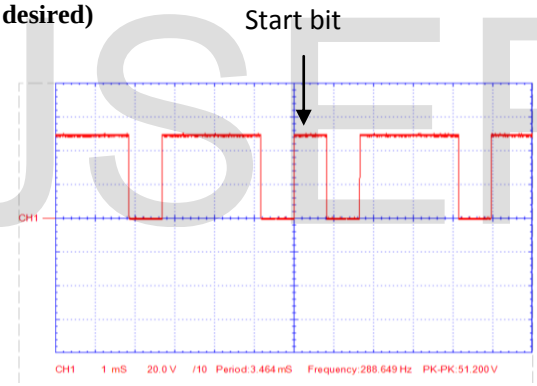


Fig. 6: Modulating Signal Waveform

Fig.6 shows the modulating signal as examined from the pin 8 of the PIC16f628 and the frequency is noted to be 1 KHz which is lesser than the carrier signal as required with the desired signal (1011101110).

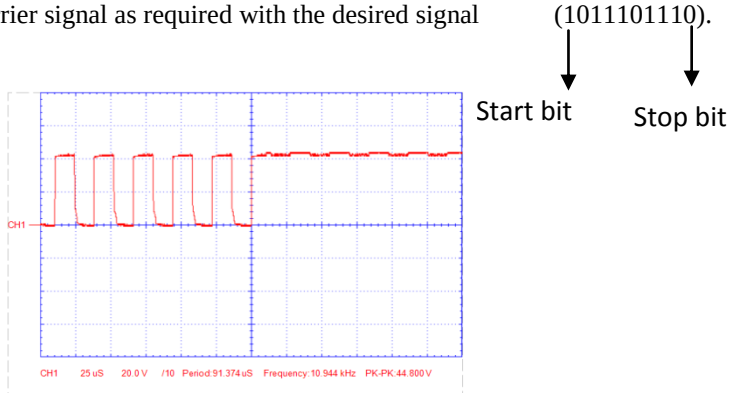


Fig.7. Modulated Signal Waveform

Fig. 7 is the output of the OR gate formed by the two diodes as taken from the cathode terminal of the connected signal diodes.

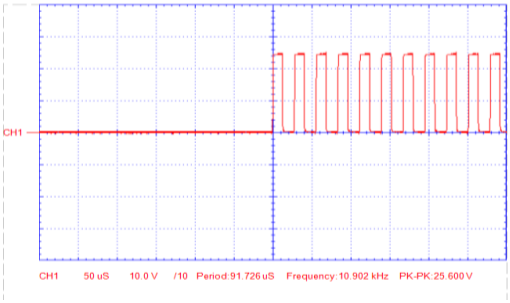


Fig.8. Inverted Modulated Signal Waveform

An inverted modulated signal from output of the Common Emitter transistor configuration as measures from the rotary potentiometer terminal (20 KHz) is shown in figure 8.

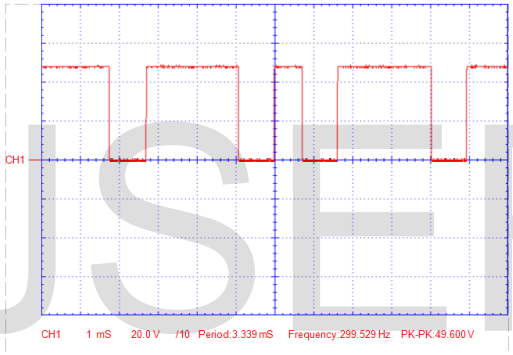


Fig 9. IR receiver Output Waveform

Fig. 9 is the output from the receiver as taken from its output leg and we observed it was the same as the Modulating signal as desired. The finished product is as shown in fig. 10 and figure 11.

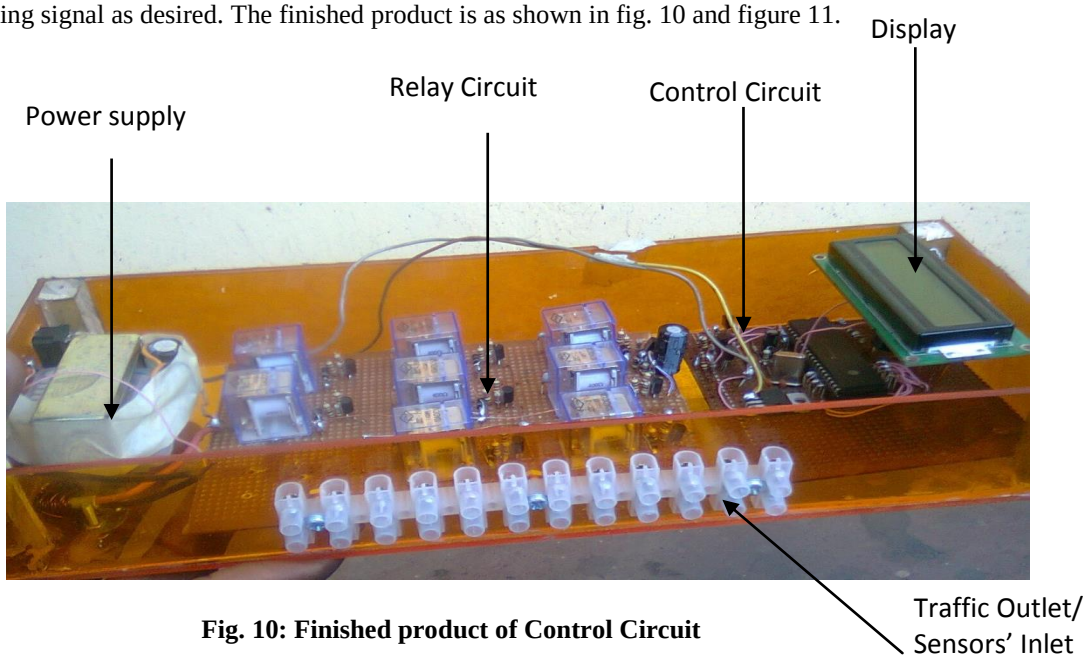
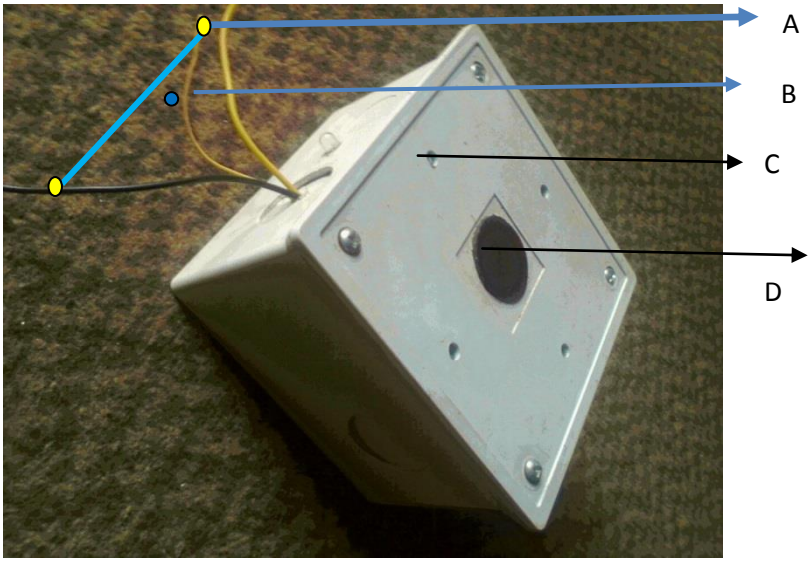


Fig. 10: Finished product of Control Circuit



A – Power Supply Terminals

B – Signal Cable

C – IR Transmitters

D - IR Receiver

Figure 11: Low Cost Active Infrared Sensor Circuits Casing

V. CONCLUSION AND FUTURE WORK

The proposed algorithm is highly cost effective in term of implementation cost and maintenance c.ost because of the locally made sensor employed. This cost effective sensor-based intelligent traffic Control system was primarily designed for University of Ibadan, Oyo State Nigeria main entrance but c.an be adopted in any situation by simply reconfiguring the sensors location on the road. We also provided keypad for Interrupt in case of emergency. More so, the keypad can change the algorithm without necessary decoupling the entire system. The designed ITCS operates real-time and hereby improved traffic flow, safety, and cost effective. The prototype demonstrated shows that it is effective in traffic management systems. GSM module shall be included in the future to report violation of 'right of road' rule.

VI. ACKNOWLEDGEMENT

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VII. REFERENCES

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