CHAPTER TWO

LITERATURE REVEIEW

2.1 Overview

This chapter explains the research related to the intelligent traffic light system using fuzzy logic and how the knowledge can be manipulated to develop the Intelligence RF Traffic Light Control for emergency vehicles. Next, the basic information about components parts isdiscussed.

2.2 Background

In a conventional traffic light controller, the lights change at constant cycle time, which is clearly not the optimal solution. It would be more feasible to pass more cars at the green interval if there are fewer cars waiting behind the red lights. Obviously, a mathematical model for this decision is enormously difficult to find. However, with fuzzy logic, it is relatively much easier, but smart Traffic Light Controller the controller is supposed to change the cycle time depending upon the density of cars behind green and red lights and the current cycle time.

2.3 Related works

"Pappis and Mamdani published the first paper in which a practical traffic and transportation problem was solved using fuzzy logic". They presented the implementation of a fuzzy logic controller (FLC) in a single intersection of two one-way streets and the results were tabulated against those corresponding to a conventional effective vehicle-actuated controller. The FLC results in a better performance with respect to the average delay of vehicles [4, 5].

Niittymaki and Maenpaaproposed the structure of rule bases for fuzzy public transport priorities and tested the fuzzy rule base using simulation and the field tests. They measured and simulated the impacts of before and after study on bus and vehicle traffic operations on an isolated intersection using the bus priority algorithm. They reported that "the results have been at least promising, and the fuzzy controllers have operated well without problems." [6]

Murat and Gedizliogludeveloped a fuzzy logic-based PS for multi-phased controlled isolated intersections and compared it with traffic-actuated control method. Their simulation studies revealed that the performance of FLC is significantly better than the actuated controller when the variation and values of traffic volumes are larger for two phased controlling situation. Fuzzy logic controller decreases delays of vehicles considerably compared with traffic-actuated control model when the traffic volumes of lanes are different [7].

Chou and Tengpresented a fuzzy logic-based traffic junction signal controller (FTJSC) that is applicable to multiple junctions and multiple lanes under a simulated environment, which is generalized by considering the number of consecutive junctions, the number of lanes, the lengths of vehicles, and the lengths of streets. The proposed FTJSC displays good performance with low, medium, and high traffic loads [8].

Kosonenintroduced a new traffic signal control methodology that combines real-time simulation, multi-agent control, and fuzzy interference.

The signal control concept, which is known as HUTSIG, is a successful and comprehensive method. The online simulation enables a control system to get access to the many aspects of traffic situations, the multi-agent type of control maintains a maximal level of freedom in control, and finally, FL provides a method to achieve a balance between efficiency, safety, and environmental objectives in traffic control [9].

Niittymaki and Turunen introduced a Lukasiewicz many-valued logic similarity based fuzzy control algorithm, tested in three realistic traffic signal control systems, and compared the obtained results to fuzzy control systems where the inference is based on standard Matlab fuzzy logic toolbox's Mamdani-style system. They reported that simulations made by HUTSIM traffic signal simulator show almost equal performances of the new control algorithm and that of standard Mamdani-style algorithm but the new algorithm gives significantly better statistical results if the traffic density is high [10].

Zhang et al.proposed a FLC and intersection control simulator (ICS) to help evaluate the FLC strategy by comparing them with pre-timed and actuated control strategies for varying traffic volumes. Based on delay, speed, percent stops, time in queue, and through-to-demand ratio statistics, the FLC strategy performed better than pre-timed and actuated control strategies under heavy traffic volumes. "ICS emulates NETSIM and integration and was designed to be able to simulate the intersection operation under pre-timed, actuated and FLC control" .It scans the traffic system and MOE at each time interval for each lane to evaluate the performance of different signal control strategies [11, 8].

Akiyama and Okushimaformulated the advanced fuzzy traffic controller using fuzzy reasoning method known as “product-sum-gravity” (PSG). The system integrates fuzzytraffic controller and traffic simulation, evaluates the performance of traffic controller, and estimates the traffic conditions affected by the fuzzy traffic control [12].

Zhang et al.proposed a two-layer fuzzy control algorithm for traffic control of the network which is supposed to have a compact central area with large traffic flow and high possibility of congestion. One part of the controller, the traffic status estimation unit, monitors the real-time traffic of an intersection using a fuzzy logic-based estimation method. The other part of the controller intends to minimize the average vehicle delay under the condition that no congestion would occur using the boundary intersections [13].

Ratrout and Olbacalibrated and validated the TRANSYT model of KAR for the local traffic conditions with respect to the queue length. The model was built based on the traffic data of off-peak hours to get reliable MOEs. [14]

W. E. Brill introduced an emergency vehicle detection system for alerting a driver of an approaching emergency vehicle includes a sound signal-producing unit mounted on an emergency vehicle, a sound signal detection unit mounted on a non-emergency vehicle, and a display unit remotely located on the non-emergency vehicle. The sound signal-producing unit has a sound generator for producing and transmitting a sound signal. A switch is used for controlling the operation of the sound generator in combination with a siren [15, 16]

Mir Roomi Rahil, Rajesh Mahind, Saurabh Chavan, Tanumay Dhar utilizes the RF circuit module, transmitter and receiver (TX-RX) for making a wireless remote, which could be used to drive an output from a distant place. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency. A four channel encoder/decoder pair has also been used in this system. The input signals, at the transmitter side, are taken through four switches while the outputs are monitored on a set of four light emitting diodes (LED) corresponding to each input switch[16,17].

2.4 System Components

To implement this project load cell sensors, ATMEGA16 microcontroller, RF (Radio Frequency) circuit and LCD are used.

2.4.1 Load Cell Sensor

A load cell sensor as shown in figure 2-1 is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various types of load cells include hydraulic load cells, pneumatic load cells and Strain gauge load cells; here strain gauge load cell is used.

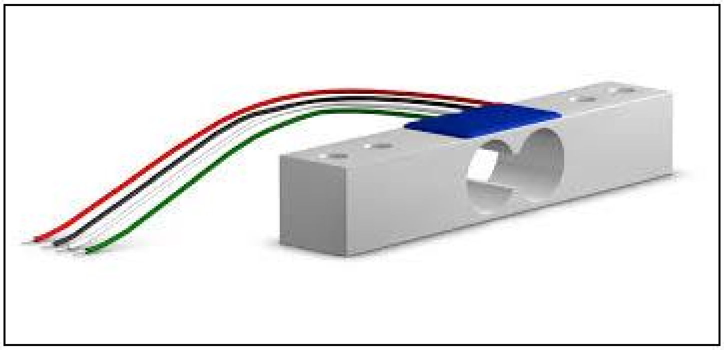

Figure 2-1: Load Cell Sensor

Strain Gauge is consist of four separate resistors connected as shown in figure2-2 which is called a Wheatstone bridge network.

The circuit of load cell sensor

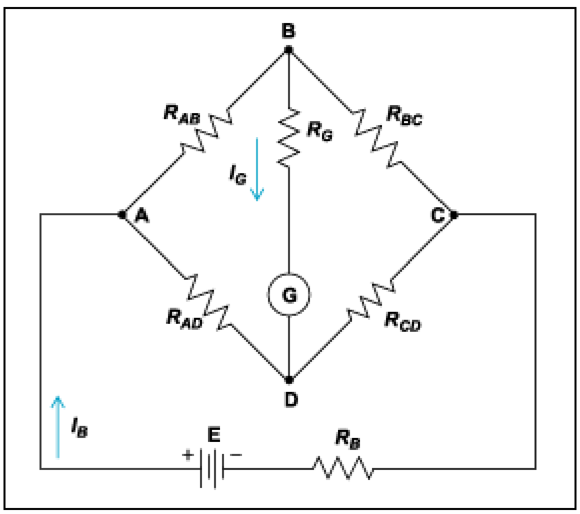

Figure 2-2: Wheatstone Bridge

At equilibrium with no applied load, the voltage output is zero or very close to zero when the four resistors are closely matched in value. That is why it is referred to as a balanced bridge circuit. When the metallic member to which the strain gauges are attached, is stressed by the application of a force, the resulting strain leads to a change in resistance in one or more of the resistors. This change in resistance results in output voltage and that indicate the vehicle has pressed the sensor.

2.4.2 ATMEGA16

This project based on microcontroller used ATMEGA16 microcontroller as shown in figure 2-3. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC (Reduced instruction set computer) architecture. It has 40 pins as shown in figure 2-4. By executing powerful instructions in a single clock cycle, the ATMEGA16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

Some Features of ATMEGA16:

1. High-performance.
2. Nonvolatile Program and Data Memories.
3. Advanced RISC Architecture.
4. JTAG (IEEE std. 1149.1 Compliant) Interface.

Special Microcontroller Features:

1. Power-on Reset and Programmable Brown-out Detection.
2. Internal Calibrated RC Oscillator.
3. External and Internal Interrupt Sources. Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and

ExtendedStandby.

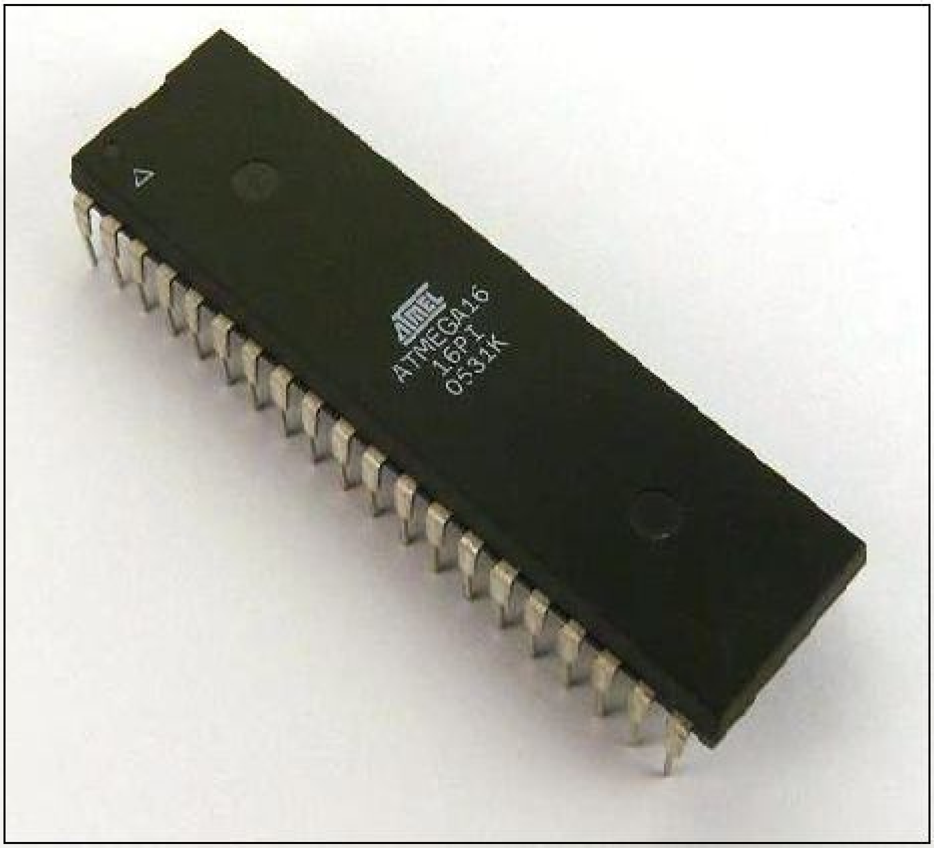

Figure 2-3: ATMEGA16 Microcontroller

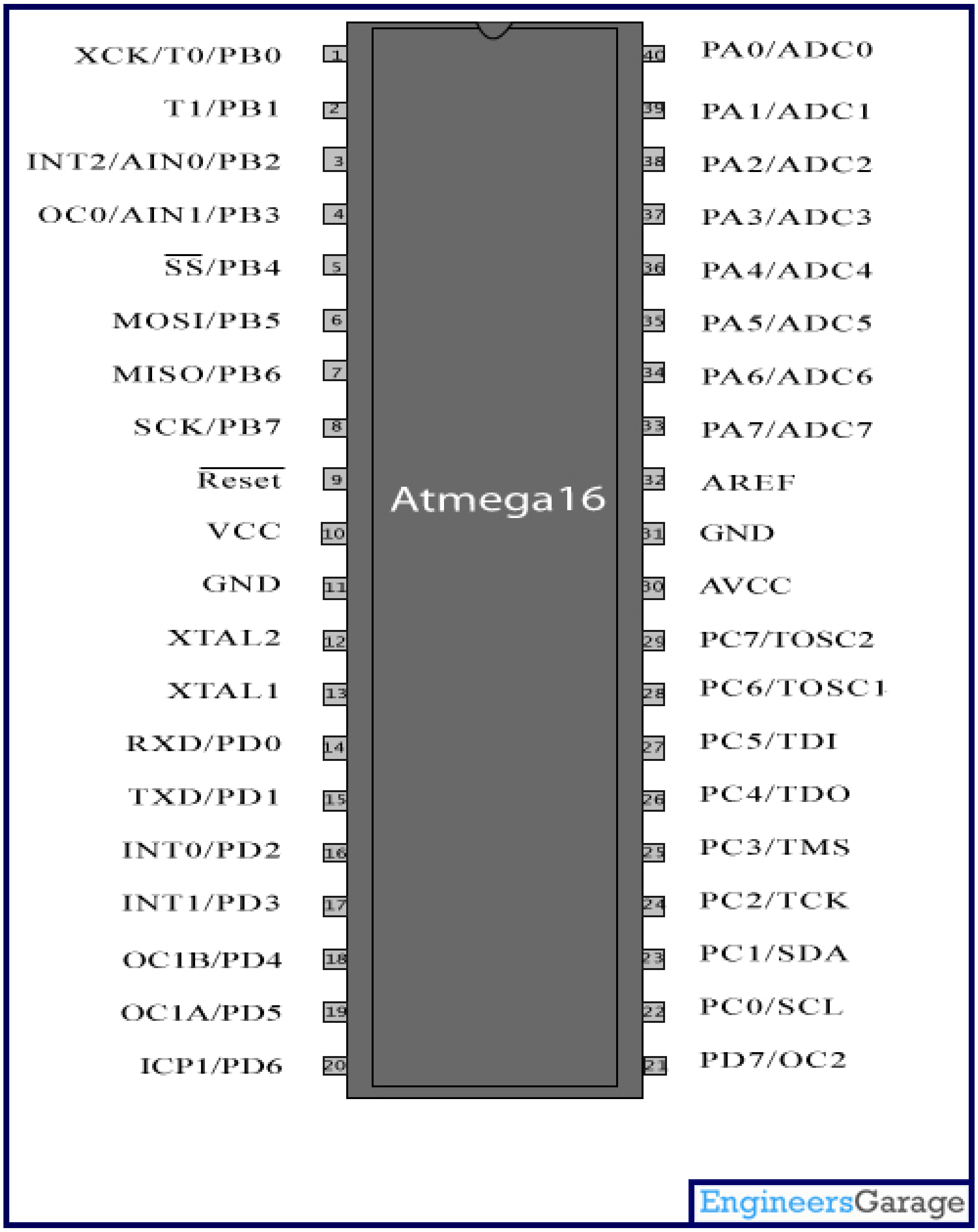

Figure 2-4: Structure of ATMEGA16 Microcontroller

Table 2-1: Pins Description

PIN1	I/O , T0 (Timer0 External Counter Input) ,XCK : USART External Clock I/O
PIN2	I/O, T1 (Timer1 External Counter Input)
PIN3	I/O, AIN0: Analog Comparator Positive Input , INT2: External Interrupt 2 Input
PIN4	I/O, AIN1: Analog Comparator Negative Input, OC0 : Timer0 Output Compare Match Output
PIN9	Reset Pin, Active Low Reset
PIN10	VCC=+5V
PIN11	GND
PIN12	XTAL2
PIN13	XTAL1
PIN14	(RXD) ,I/O PIN 0,USART Serial Communication Interface
PIN15	(TXD) ,I/O Pin 1,USART Serial Communication Interface
PIN16	(INT0),I/O Pin 2, External Interrupt INT0
PIN17	(INT1),I/O Pin 3, External Interrupt INT1
PIN18	(OC1B),I/O Pin 4, PWM Channel Outputs
PIN19	(OC1A),I/O Pin 5, PWM Channel Outputs
PIN20	(ICP), I/O Pin 6, Timer/Counter1 Input Capture Pin
PIN21	(OC2),I/O Pin 7,Timer/Counter2 Output Compare Match Output
PIN22	(SCL),I/O Pin 0,TWI Interface

PIN23	(SDA),I/O Pin 1,TWI Interface
PIN24 PIN27	JTAG INTERFACE
PIN28	(TOSC1),I/O Pin 6,Timer Oscillator Pin 1
PIN29	(TOSC2),I/O Pin 7,Timer Oscillator Pin 2
PIN30	AVCC (for ADC)
PIN31	GND (for ADC)
PIN33 PIN40	PAx: I/O,ADCx (Where x is 7 – 0)

2.4.3 RF circuit

The basic concept of operation is as follows:

1. Receiver and Transmitter :

For the receiver as shown in figure 2-5, the signal from the antenna is amplified in the radio frequency (RF) stage. The output of the RF stage is one input of a mixer. A Local Oscillator (LO) is the other input. The output of the mixer is at the Intermediate Frequency (IF). The concept here is that it is much easier to build a high gain amplifier string at a narrow frequency band than it is to build a wideband, high gain amplifier. Also, the modulation bandwidth is typically very much smaller than the carrier frequency. A second mixer stage converts the signal to the baseband. The signal is then demodulated. The modulation technique is independent from the receiver technology. The modulation scheme could be amplitude modulation (AM), frequency modulation (FM), phase modulation or some form of quadrature amplitude modulation (QAM), which is a combination of amplitude and phase modulation.

On the transmit side as shown in figure 2-6 the mixers convert the frequencies up instead of down [18].

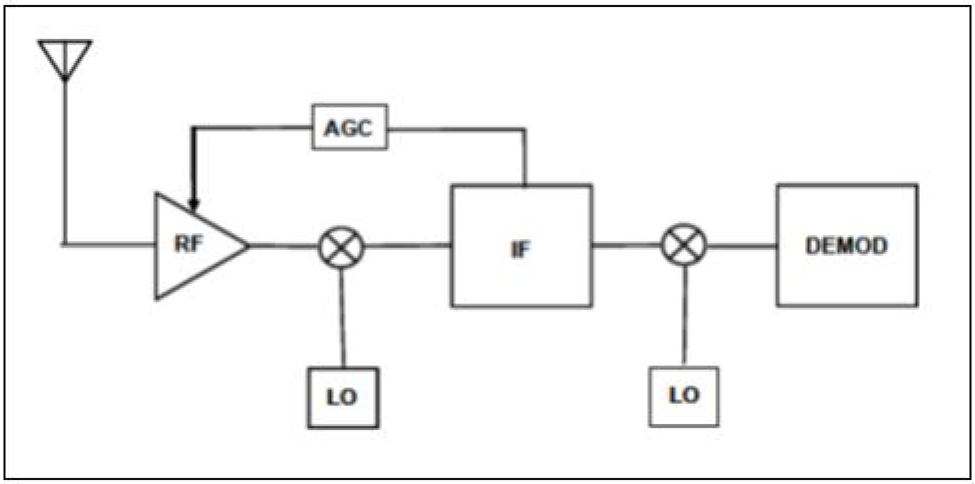

Figure 2-5: Basic Superheterodyne Radio Receiver

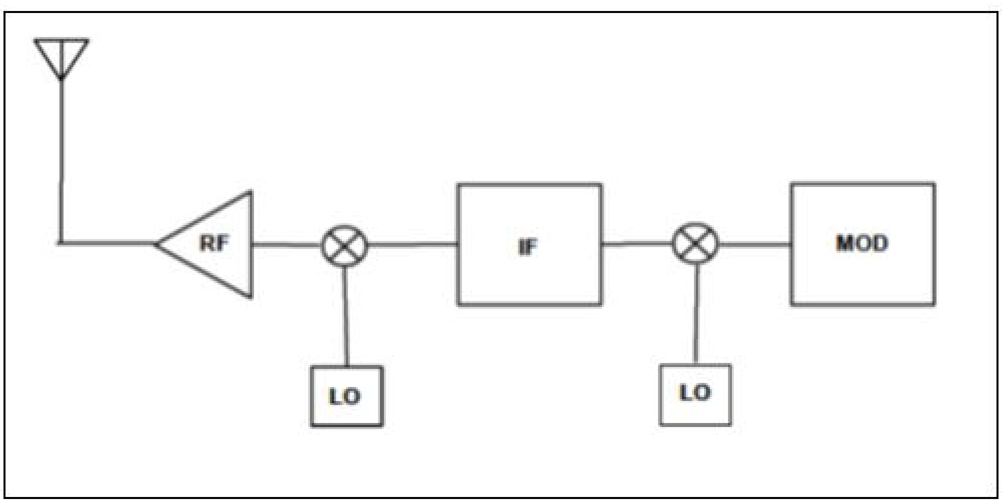

Figure 2-6: Basic Super heterodyne Radio Transmitter

Figure 2-7: RF Transmitter and Receiver

2. Encoder:

An encoder as shown in figure 2-7 is a device or entity that will encode information in a particular way, compressing, converting or securing it into a different format. Since there are three traffic lights at the intersection, multiple channels encoderis used for this project [17].

Figure 2-8: Encoder

3. Decoder:

A decoder as shown in figure 2-9 is the device or entity that removes the information from; it's previously encoded state and returns it to its original format. The decoder must have the same number of channels with the encoder [17].

Figure 2-9: Decoder

2.4.4 Fuzzy logic

The artificial intelligent (AI) is an area of computer science that emphasizes the creation of an intelligent machines that work and reacts like humans. Fuzzy logic is form of AI, therefore it would be considered as subset of AI. The term *fuzzy logic* was introduced with the 1965 proposal of fuzzy set theory by LotfiZadeh.Fuzzy Logic (FL) is a method of reasoning that resembles human reasoning. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values YES and NO [19].

It is a type of logic that recognizes more than simple true and false values. With fuzzy logic, propositions can be represented with degrees of truthfulness and falsehood.Fuzzy logic is conceptually easy to understand, flexible, can be built on top of the experience of experts and based on natural language.

2.4.5 LCD

LCD (liquid crystal display) as shown in figure 2-10 is a device used for displaying.

Figure 2-10: LCD