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20 - 21, June 2012
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PREFACE

The activities of the International Conference is in line and very appropriate with the vision and mission of the UBL to promote training and education as well as research in these areas.

On behave of the First International Conference of Engineering and Technology Development (ICETD 2012) organizing committee; we are very pleased with the very good responses especially from the keynote speakers and from the participants. It is noteworthy to point out that about 45 technical papers were received for this conference

The participants of conference come from many well known universities, among others: Universitas Bandar Lampung, International Islamic University Malaysia, University Malaysia Trengganu, Nanyang Technological University, Curtin University of Technology Australia, University Putra Malaysia, Jamal Mohamed College India, ITB, Mercu Buana University, National University Malaysia, Surya Institute Jakarta, Diponogoro University, Unila, Universitas Malahayati, University Pelita Harapan, STIMIK Kristen Newmann, BPPT Lampung, Nurtanio University Bandung, STIMIK Tarakanita, University Sultan Ageng Tirtayasa, and Pelita Bangsa.

I would like to express my deepest gratitude to the International Advisory Board members, sponsors and also welcome to all keynote speakers and all participants. I am also grateful to all organizing committee and all of the reviewers which contribute to the high standard of the conference. Also I would like to express my deepest gratitude to the Rector which give us endless support to these activities, such that the conference can be administrated on time.

Bandar Lampung, 20 Juni 2012

Mustofa Usman, Ph.D
ICETD Chairman

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Fuzzy Logic Applied to Intelligent Traffic Light

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Abstract- **Traffic congestion is an obstacle in the big cities. Traffic light as a way of the traffic regulation to be a solution right now. With the installation of digital numbers as a counter in the lane of traffic light that can give time to continue to move to indicate the length of the queue's turn at the intersection, is currently widely used on path scrossing, or intersection of roads in Indonesia. However, for a continuous density in traffic, can increases the counte rof traffic light at any time, should always be arranged, there's so incovenience to the rider.**

This research is a about development called intelligent traffic light that is able toadapt wellto the congestion that occurs inthe traffic lane controlled byt raffic lights. By utilizing ATMega AVR-32 on electrical hardware development which will be applied to simulated traffic light and with the use of digital cameras that observ ethe density of the lane,would bea complete automation solution for paths run properly.

Fuzzy algorithms will calculate carefully based on the information transmitted by the camera into microcontroller, then processed and rendered a decision which path in the lane is allowed to be run. High-density or Low-density in the lane of roads, will be important information for the fuzzy logic to determine whether the decision to. Finally, with these applied hardware and the implementation of fuzzy algorithms will be handled traffic on the lane intelligently.

Keywords— Fuzzy Algorithm, Intelligent Traffic Light, Microcontroller, AVR-ATMega328, Arduino, CMU CAM

I. INTRODUCTION

Traffic Light in Indonesia nearly a whole using the digit counter to indicate the remaining time that happened at a red light and green light, which indicates how long the remaining time to stop, when the red light conditions, and the rest of the time how long to be through the traffic light bulbs sasaat green light. A moment's digit counter has a function that is good enough to arrange queues of motorists and road users, but for the conditions provide a better chance of automatically at any time on the road with a long red light or green for a long time can not be done, because the system only stores the timings manually.

In this research prepared a smart traffic light system which can provide the red light or green light that is more dynamic. If one of the roads are crowded, then the green light will turn on much longer, the quiet roads will have a shorter green light. With this condition eventually the traffic will be resolved properly. All of which will have a balance frequency of the light is more appropriate. If the roads are generally quiet, but then has a high density, then the side of the road will get quite a long time anyway.

The intelligent method of making these decisions based microcontrollers are built using fuzzy method. As supporting information before a decision is made with fuzzy methods, data traffic density was observed from a camera mounted on every street that has traffic light, which will report the results of which are owned by the density of each road segment.

Using microcontroller AVR ATMega328 that mounted on a board Arduino Uno to provided this intelligent traffic light, while the camera is used CMU-CAM version 4, which has 8 core processor to obtain information such as imaging with faster results than the previous version of the CMU-CAM.Other enhancements are used to help the performance of the CMU-CAM is a servo motor to move the camera in taking the object

II. THEORY BASIS

2.1 Microcontroller

Microcontroller is a miniature of computer. Inside in there is a single chip core of its processor, memory, ROM and input-output controllers in the form of analog and digital. In addition, the microcontroller also has the same means of communication with the computer to connect to other devices. It uses a form of communication UART (Universal Asynchronous Receiver Transmitter) and USART (Universal Synchronous / Asynchronous Receiver Transceiver). Both forms of communication is a form of computer communication standards.

Microcontroller has a much lower speed than the microprocessor in the computer. Microcontroller only has a data processing speed is below 20 MHz, while the computer has a top speed of 100 Mhz, even today's computers has reached thousands Mhz or commonly known as gigahertz.

Microcontroller also has a data management procedures and processes such as computer-based 4 bit, 8 bit, 16 bit, even the type ARM microcontroller, already has the data management of up to 32 bits.

With the capabilities of 16-bit microcontroller, it has been enough to solve the problems in the handling of intelligent systems using fuzzy methods are executed directly without the aid of a microprocessor or computer transfer process.

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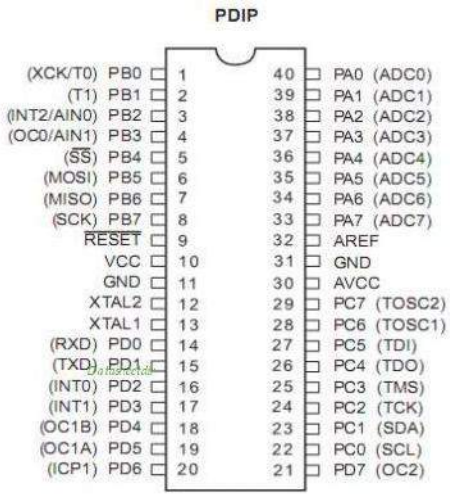

Fig.1. ATMega328 Pin-Out

Microcontroller is commonly used in smart electronic devices that can perform fast data management and decision-making, both essential tools such as medicine and weapons combat, but also on household devices that require sophistication in the management process, such as air conditioning, engine wash, Engine Cooling (Refrigerator) and to the injection engine management is important in modern cars and motorcycles.

2.2 Arduino UNO

Arduino is an Italian company from the manufacturer for a microcontroller prototyping. AVR-ATMega and PIC microcontroller is a type that is currently developed by the Arduinoprototypingnya. The official website of the Arduino is on http://www.arduino.cc.

Some of its famous product is the Arduino UNO, ArduinoDumielanove, ArduinoLeonardo and Arduino Mega. That three products using the AVR-microcontroller ATMega.

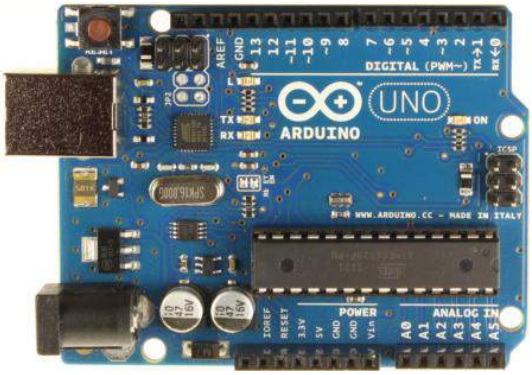

Fig.2Arduino UNO prototyping board

In this research used an Arduino UNO, due to having good facilities and the price is relatively cheaper, compared to other types of Arduino. Speed data management with the microcontroller is also sufficient to address the traffic light which will be discussed in this study.

2.3 CMU-CAM

CMU is stands for Carnegie Mellon University, an institution of higher education in America, specifically in Oakland, which is located near Pittsburgh. The campus has a project that eventually made him famous with its camera, which can be connected to the embedded device controlled by the microcontroller. CMU-CAM is a camera products.

CMU-CAM to date have been included in version 4, commonly known as CMU-CAM4, open-source project that is in it to be an attraction for the developers to continue to be able to develop the capabilities of this device in software and hardware with better.

Fig.3 CMU-Cam 4 board

As computer vision sensor, CMU-CAM has a fairly good ability to be able to detect the information provided. In this research used the CMU-CAM version 4 which has been integrated with artificial Parallax propeller chip, ie.chip P8X32A which has 8 core processor to assist in the management of information on its camera lens.

CMU-CAM 4 has two servo controller controls the facility to move horizontally and vertically. In this research utilized the servo that moves vertically, to see the condition of traffic density with a wider range.

2.4 Fuzzy Method

Fuzzy is a pretty old method as a tool to help decision-making. This method is a form of reasoning to provide a permanent and appropriate approach. In a time when the conditions are vague (fuzziness) appears, and the determination of appropriate conditions is very difficult to determine. Constant value assigned to deliver a valued fuzzy decision also be complicated to be given. Therefore, the fuzzy method is used to obtain information from the decision of the faint (fuzziness) and directed to form a crisp information (firm). Applied Fuzzy Logic can be described on the following formula.

$$A = \left\{ \sum_{x_i \in X} \mu_A(x_i) \right\} \left\{ \int_x \frac{\mu_A(x)}{x} \right\}$$

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Some of the processes associated with the fuzzy method is the process of normalization, fuzzification, inference, defuzzification and denormalization. When the process has reached a condition denormalisasi, the vague information obtained will eventually be translated into information that firm value (crisp) and ends on the decision.

III. Design Approach

3.1 Traffic Circulation

This system will be applied at aintersection, where there are four different directions sections must be completed and the traffic issues be balanced with the determination of the dynamic value of the length of the red light to stop and status as a green light status to be run.

CMU-CAM camera as a source to give an information for determining this decision is placed above the traffic light bulbs mounted on the roadway. The information generated by the CMU-CAM form of the percentage of traffic density, with the value of light density, medium density and high density. A value of light density it means that the road is empty, or has a few vehicle. Whereas a value of high denstry certain that the area is filled with vehicle in the camera that surveillance the side of ways.

Other input conditions as well as determining the length of time the decision is one road to get to any of the lights, either red or green light. Despite having one of the road of excess density and given the provisions of a long time, but the condition of the "long time" is also still have an end, having to switch on another path that might have a lighter density. This means that although one of the lines is quite solid, but still has a limit for the given constant displacement on the status lights on the other. Green light should not be too long on one of the crowded roads, other roads also remain light density was calculated to be given the green light status.

Determining the length of time given is in seconds. The balance of time given to the road is different, depending on the density of existing roads. Circulation of the decision to change the status lights would also be a constant, which originated from the streets A, B, C and D, and so on. Provisions of one of the active length of the light values are volatile, but the circulation path is fixed, ie roads A, B, C and D (as in Fig. 1), but if one had densities road from vehicles, then the circulation can be transferred to segment another way, for example road B has a light density of traffic, then the circulation path in the order A, C, D in the circulation flow B is ignored for a while.

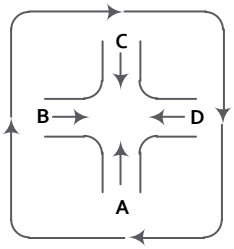

Fig4. Perempatan Jalan dan Sirkulasi Arus Jalan

Circulation changes at the intersection lights are in a clockwise direction. As in Fig. 4. If the density on one side of the road is very high, then the system will also continue to provide a deadline for one of the lights are on, either red or green for a maximum of twenty-five (25) seconds. Turn the lights change will be given on the other side of the road and given a clockwise circular sequence as Fig. 4.

3.2 Fuzziness Condition of Traffic Density

Fuzziness of conditions resulting from the camera sensor to provide information about the density of the road. Each side of the street lights installed traffic light and a camera mounted on it, the area is divided into twelve (12) area. The twelve areas are areas of an image area of 80 x 60 pixel generated by the camera. Road density is divided into three, namely light-density, medium density and high density.

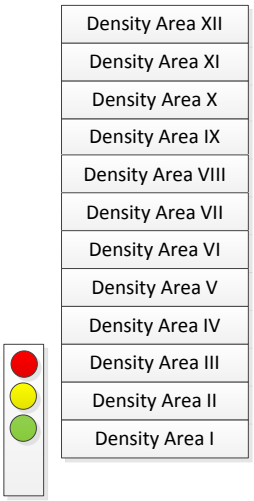

Fig. 5. Density Area

All four sides of the road mounted traffic light is divided into twelve (12) area density (as in Fig. 5). The higher the density, the longer it will be given on the road to quickly take a turn to get the green light. Fuzzy graph for the completion of fuzziness on the density of road conditions contained in Fig. 6.Some of the selected area to be lighter density, medium density and high density.

Fuzzy value domain to the provisions of the density can be observed in Table 1. Fuzzy graph presented in Fig. 6.

TABLE I
Fuzzy Domain Value for Traffic Density

Fuzzy Domain Atribut	Value
Light density	<6
Medium density	4 – 10
High density	>8

In the fuzzy domain as found in table 1, can be added to provide additional supporting variable conditions more detail in the handling of traffic, with the increasing number of domain attributes will make the more complicated the handling of applications.

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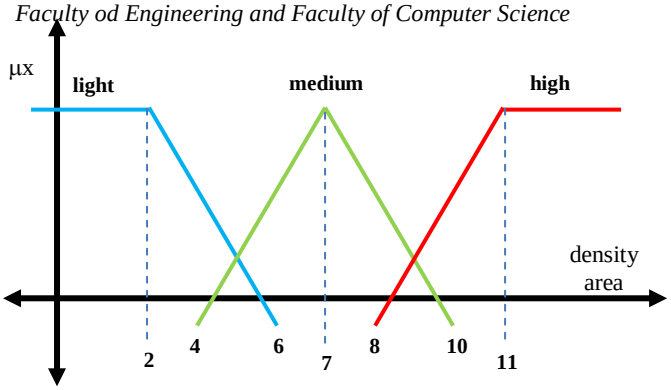

Fig. 6.Fuzzy Traffic Density Graph

Some examples of calculations using the density of the graph is as follows. An example occurs when the density in area V, it will display two important conditions, namely the density of light and medium density. If the area density values calculated V light, then the calculation is - (5-6) / (6-2) = 0.2. Value will be compared with the value of V if the area entered the medium density. The calculation is (5-4) / (7-4) = 0.3. with this condition, the area V into the medium density.

Density is likely to apply to each line of equal value. It is therefore necessary to limit the maximum value of each traffic lane. Each track has a time limit of 25 seconds, for the red and green lights. For yellow light is activated when the traffic is given completely blank on one track. For the solid line, the yellow light is given for two (2) seconds. Conditions of the yellow light is given to allow time for preparing a solid track with good stops. Do not let the end user stops at the crosswalk lines due to the direct light is red, after the green light., Which ultimately affected motorists of traffic violations.

For the direct path have light density at the green light, the light turns red is directly.

There are three (3) seconds before moving other lines experiencing light displacement. These conditions are given to prevent traffic better stability, so that traffic could be empty in the middle of the intersection.

Time required on one track if it has a high density is 25 seconds the red light, yellow light added 2 seconds and added another 3 seconds for the idle condition, obtained within 30 seconds. Total time for the four-lane traffic is 4 x 30 seconds = 120 seconds or 2 minutes.

In the Fig. 7, the flowchart presented aplikasi. Can be observed that the main principle in this application is the result of observation of the camera, which then processed the data owned by the fuzzy domain. If there is no traffic, then the red light is always on, to wait for the density in one lane of traffic lights.

Camera will always detect the presence of the whole of the lane at intersections. All conditions will be reported to the microcontroller, in real time. When conditions change rapidly, so as soon as it is also a system with fuzzy method will change the status of the red light to green or vice versa.

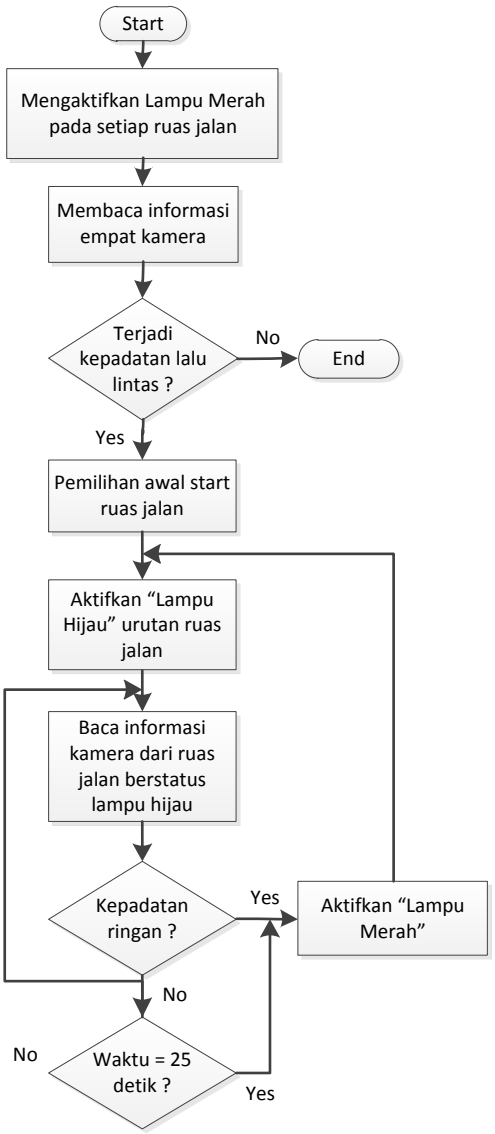

Fig. 7 FlowchartSystem

Wrong selection of microcontroller and improper camera will make a "lag" on a system to works, microcontroller which has a low processing speed will make the process of decision making with fuzzy methods will be obstructed. Therefore by the right camera as CMU-CAM 4 which has 8 core processor can help the process of the microcontroller to be lighter, because the separate processing.

To facilitate the observation on intelligent traffic light in this research is applied, also presented an application that can simulate the visual treatment of the use of applied fuzzy intersection. On the application of the simulation (Fig. 8) are presented, traffic can also be created directly, to see what's happening with traffic lights and fuzzy logic are the focus in this study.

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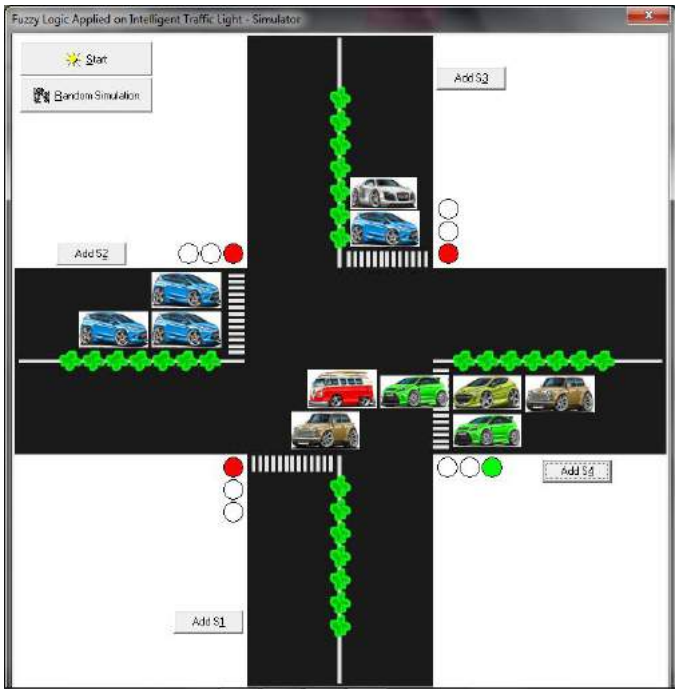

Fig.8 Sumulation Aplication Traffic

IV. CONCLUSIONS

Congestion on the highway sometimes also be created from the incorrect handling of the traffic light. Applied wait times are set statically will create the queue length increases in traffic, due to conditions that have to wait another turn lane and stopped for a red light. Fuzzy logic applied to the traffic light on this research will make a stop or red light to green light for a dynamic running status.

If another path does not have a vehicle that stops, then the process will move to another line that was being dense or is there a running vehicle. If traffic is dense, then the cycle will run by default, the red light turns on for 25 seconds and the green light turns on for 25 seconds. But when there is enough light density as the data is processed the system, the dynamic processes in the light will work.

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