CHAPTER I

INTRODUCTION

1.1. Background

Science and technology are growing rapidly over time. The development of science has spurred the development of technology that is useful in facilitating the work of all human activities. Thus, more technology development, the greater the need for electricity is, while the source or power plant is very limited. The design of an automatic fan based on temperature and human motion detection in room is a system that can assist in daily needs and according to the needs expected by many people who use fans, aiming at comfort for the lower and upper middle class people.

On this occasion, an idea arises to try a system, namely the control system that uses the Atmega8 Microcontroller. It is indeed a new breakthrough technology as a substitute for a series of conventional relays that can be programmable based on logic. Therefore, in the case of implementing a microcontroller for the automatic control system on fan, it is necessary to examine more deeply how and why this system can work as expected to meet the needs of others so that, in the future, it can be applied directly to the community of Indonesia. Therefore, it can realize the role of students participating in community service in the context of increasing development in community needs. This study uses title "Design of Automatic Fan Control Based on Room Temperature and Human Movement".

1.2. Formulation of Question

The question formulated in this study are:

a) How is to design a room temperature regulation system automatically based on human motion and room temperature;

b) How is to assemble a system with Atmega8 Microcontroller and two temperature sensors to work in accordance with its function;

c) How is to make the software run a microcontroller circuit.

1.3. Problem Limitation

a) The design uses an Atmega8 controller as a system controller.

b) The design uses an LM 35 temperature sensor for room temperature detection and a pear sensor for detecting human motion.

c) The design uses C programming language with CV AVR editor version 2.0.4.9 to compile programs that run the system.

1.4. Purpose

The purposes of this study are:

a) To design a rotational speed regulation system of fan based on temperature detection and human motion;

b) To make a controller circuit with Atmega 8 and sensor 2.3; and

c) To create a control program using C language (type of programming) to run the system.

1.5. Objective

The expected objectives of this research are:

a) To design a fan is only useful as a system that helps save electrical energy because it can function when there is an activity in the room.

b) To make the system work automatically based on temperature settings and human motion, thus providing convenience in regulating room temperature through changes in rotational speed of the fan motor as to provide comfort to room visitors/users.

1.6. Systematics of Study Writing

To obtain maximum result in completing this study, the author made the following discussion sequence:

CHAPTER I describes background, formulation of question, limitation of question, purposes, objectives and writing systematics used in completing this study. CHAPTER II contains the scope of concepts and supporting theories that forming basis to design the tool to make. CHAPTER III discusses the technique of designing tools, assembling tools, and compiling programs. Furthermore, CHAPTER IV discusses testing design results obtained from the made design of tools and analyzing the test results. Finally, CHAPTER V discusses the conclusions from all the results of the observation data and recommendations from the study material discussed for development.

CHAPTER II

LITERATURE REVIEW

2.1. Atmega8 AVR Microcontroller

According to Ardi Winoto (2011:1), Microcontroller is an IC with a very high density, where all the parts needed for a controller are packaged in one chip, usually consisting of CPU (*Central Processing Unit*), RAM (*Random Access Memory*), EEPROM. (*Electrical Erasable Programmable Read Only Memory*)/EPROM(*Electrical Programmable Read Only Memory*)/ROM (*Read Only Memory*) I/O (*Input/Output*) Serial and Parallel, *Timer* with *Interrupt Controller*.

In general, a microcontroller is a computer having various functions used to control an electronic device, emphasize efficiency and cost effectiveness called "*small controllers*" where an electronic system previously required many supporting components such as IC (*Integrated Circuit*), TTL (*Transistor Transistor Logic*), and CMOS (*Circuit Metal Oxide Semiconductor*) can be reduced / minimized and finally centralized and controlled by the Microcontroller. AVR (*Atmel Norway Design*) is one type of microcontroller having various functions. The difference in micro generally used like MCS51 (*Metal Circuit Semiconductor*) is that the AVR does not need to use an external oscillator because it already has an internal oscillator. In addition, the advantage of the AVR is that it has a power-on reset, which means that there is no need for a reset button outside because it is enough just to turn the supply off, the AVR will automatically reset. AVR has several special functions such as ADC (*Analog to Digital Circuit*) EEPROM around 128 bytes = 1024 bits to 512 bytes or = 4096 bits. AVR Atmega8 is an 8-bit CMOS Microcontroller with AVR RISC architecture having 8 k bytes of in-System Programmable Flash. Microcontroller with low power consumption is capable of executing instructions with maximum speed of 16 MIPS at the frequency of 16 MHZ. When compared to Atmega8 type L, the difference only lies in the number of voltages needed to work. For Atmega8 type L, this microcontroller can work in voltages between 2.7 – 5.5 V, while for Atmega8, it can only work in voltages between 4.5 – 5.5 V.

2.2. Atmega8 Pin Configuration

Figure 2.1 shows Atmega8 pin configurations, each of which has the following functions:

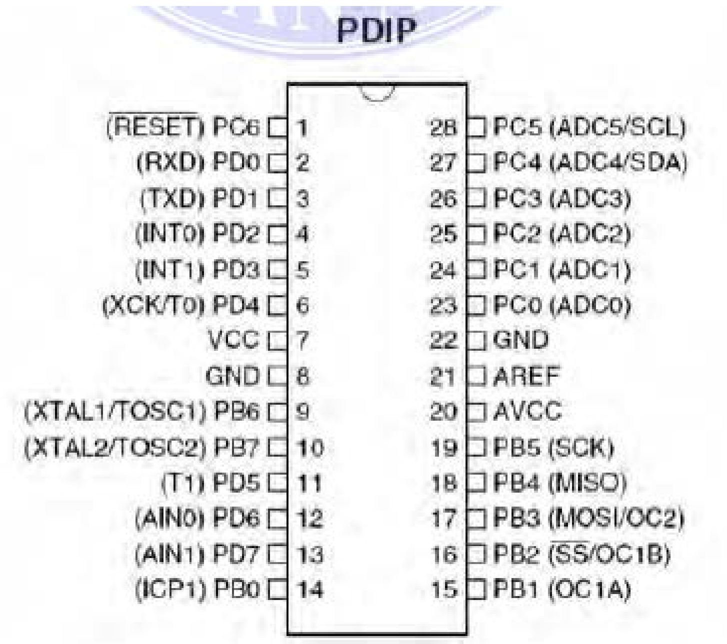

Figure 2.1. Atmega8 Pin Configuration (www.google.co.id/atmega8)

Atmega8 has 28 pins, each of which has a different function as a port or other functions. The following explains the function of each pin of Atmega8.

- VCC (*Voltage Controlled Current*)

  It is a digital voltage *supply*.

- GND (*ground*)

  It is ground for all components that require grounding.

- PORT B

  (PB7...PB0) In PortB consists of XTAL1, XTAL2, TOSC1, TOSC2. The number of PortB is 8 pins, starting from pin B.0 to B.7. Each pin can function as *input* or *output*. PortB is an 8-bit bi-directional I/O with an internal *pull-up* resistor. As input, the pins on port B are externally lowered, it will output current if the *pull-up* resistor is activated. Specifically, the PB6 can function as both a Crystal input (*inverting oscillator amplifier*) and an internal clock circuit input, depending on the Fuse bit setting used to select the clock source. Meanwhile, PB7 can function as a Crystal output (*output oscillator amplifier*) depending on the Fuse bit set used to select the clock source. If the clock source is selectable from the internal oscillator, PB7 and PB6 can function as I/O or if using Asynchronous Timer/Counter 2 then PB6 and PB7 (TOSC2 and TOSC1) are usable for the timer input line.

- PORT C

(PC5...PC0) is a 7-bit bi-directional I/O port in which each pin contains a *pull-up* resistor. The number of pins is only 7 pins starting from pin C.0 to pin C.6. As an output, port C has the same characteristics in terms of absorbing current (*sink*) or issuing current (*source*).

- RESET/PC6

If the RSTDISBL fuse is programmed, then PC6 will function as an I/O pin. This pin has different characteristics from the pins found on other C ports. However, if the RSTDISBL fuse is not programmed, then this pin will function as a reset input. If the voltage level entering this pin is low and the pulse is shorter than the minimum pulse, it will result in a reset condition even though the clock is not working.

- PORT D

(PD7 ... PD0) Pord D is an 8-bit bi-directional I/O with an internal *pull-up* resistor. The function of this port is the same as the other ports. It's just that there are no other uses on this port. This port only serves as input and output or is commonly referred to as I/O.

- AvccPin

This AvccPin serves as a voltage *supply* for the ADC. This *pin* must be connected separately to VCC because this *pin* is used for analog only. Even if the ADC on the AVR is not being used, it is still advisable to connect it separately to the VCC. If ADC is used, then Avcc must be connected to VCC through a *low pass filter*.

- AREF

It is the reference pin if using the ADC.

The AVR status register contains some information about the result of most arithmetic instruction executions. This information is used for altering program currents as a means to improve operating performance. This register is updated after the ALU (*Arithmetic Logic Unit*) operation, it is as written in the datasheet, especially in the Instruction Set Reference section. In some cases, this can eliminate the need for dedicated comparison instructions and can result in speed improvements and simpler and shorter code. This register is not automatically saved when entering an interrupt routine and when executing a command after returning from an interrupt. However, this must be done through software. Figure 2.2 shows Atmega8 status register.

Bit	7	6	5	4	3	2	1	0	
	I	T	H	S	V	N	Z	C	SREG
Read/write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
InitialValue	0	0	0	0	0	0	0	0	

Gambar2.2 Atmega8 Status Register (www.atmel.com)

Bit 7 (I)

It is the Global Interrupt Enable bit. This bit must be set for all interrupt commands to be executable. Individual interrupt commands will be explained in another section. If this bit is reset, all interrupt commands, both individual and general, will be ignored. This bit will be cleared by the hardware after an interrupt is executed and will be reset by the RETI (*ritten* *interrupt*) command. This bit can also be set and reset through the application and the SEI (*set interrupt*) and CLL (*clear interrupt*) instructions.

- Bit 6 (T)

It represents *Copy Storage bit*. The *Copy Instruction* BLD (*Bit Load*) and BST (*Bit Store*) bit instructions use this bit as the origin or destination for the bit operated. A bit from a register in the register file can be copied into this bit by using the BST (*bit store*) instruction, and a bit in this bit can be copied into the bit register in the register file using the BLD (*bit load*) command.

- Bit 5 (H)

It is the *Half Carry Flag* bit. This bit indicates a *Half Carry* in some arithmetic operations. This bit works in BCD arithmetic.

- Bit 4 (S)

It represents *sign bit*. This bit is always an exclusive between the *Negative Flag* (N) and the *two's Complement Overflow Flag* (V).

- Bit 3 (V)

It represents *bit two's Complement Overflow Flag*. This bit provides a two's complement arithmetic function.

- Bit 2 (N)

It is a *Bit Negative Flag*. This bit indicates a negative result in a logical or arithmetic function.

- Bit 1 (Z)

It is *Zero Flag bit*. This bit indicates a zero result "0" in an arithmetic or logical function.

- Bit 0 (C)

It represents the *Carry Flag bit*. This bit indicates a carry or remainder in arithmetic or logic.

- Timer/Counter

Timer/Counter 0 is a *timer/counter* that can count pulse/clock sources either inside the *chip* (timer) or outside the *chip* (counter) with a capacity of 8-bit or 256 counts. The timer/counter can also be usable for:

a. Regular timer/counter.

b. Clear Timer on Compare Match (other than Atmega8).

c. Frequency generator (other than Atmega8).

2.2.1. Serial Communication On Atmega8

The AVR Atmega8 microcontroller has a USART (*universal serial asynchronous resist transmit*) port, which means serial communication on Pin 2 and pin 3 for data communication between the microcontroller and the Microcontroller or the Microcontroller and a computer. USART can function as synchronous and asynchronous data transmission. Synchronous means that the *clock* used between the transmitter and receiver is one clock source. While asynchronous indicates that the transmitter and receiver have their own clock sources. USART consists of three blocks, namely the *clock generator*, *transmitter*, and *receiver*.

2.3. Transistor

Figure 2.3 shows resistor symbols as follows:

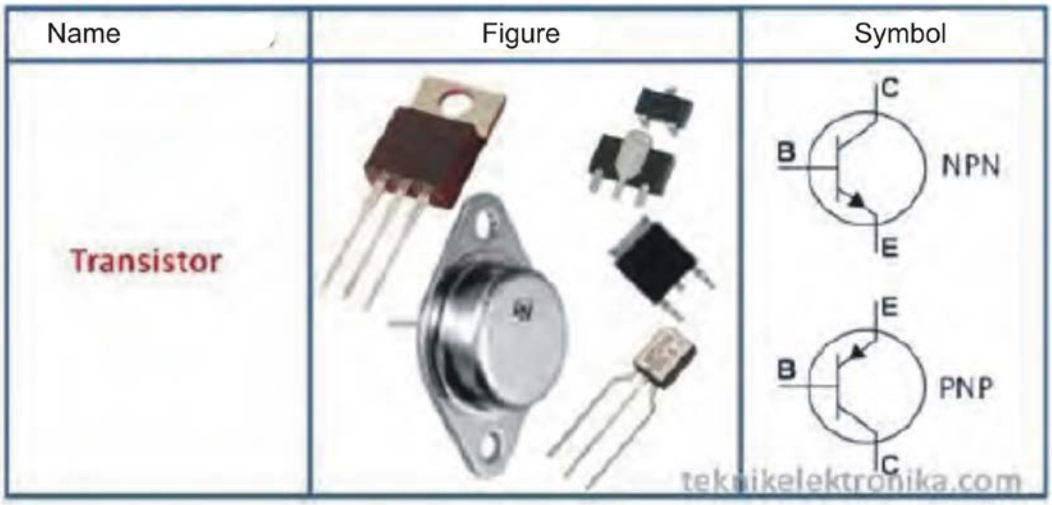

Figure 2.3 Transistor Symbol (http://4.bp.blogspot.com)

A transistor is an electronic component made of semiconductor material having three pins or three electrodes (triode), the pins are the base (B), collector (C) and emitter (E). Transistor comes from two words, namely the words *transfer* and *resistor* characterizing the meaning of the *transfer* or *transition* of material (*semi-conductor*) *half-conductor* into a conductor at a certain temperature. William Shockley, John Barden, and W. H Brattain firstly invented the transistor. In an electronic circuit, the letter Q symbolizes the transistor.

A transistor is the first electronic component that ushered in the world of ancient electronics to modern electronics. Generally, transistors function as switches and components of voltage or electric current amplifiers.

In general, there are 2 types of transistor:

a. Bipolar Transistor

b. Unipolar Transistor

Bipolar transistor works with two types of carriers, while unipolar transistor only works with one type, hole or electron. Table 2.1 shows some comparisons of bipolar and unipolar transistors:

Table 2.1 Comparison of Bipolar and Unipolar Transistors.

	Bipolar	**Unipolar**
Dimension	Big	Small
Power	High	Low
Bandwidth	Wide	Narrow
Response	High	Medium
Input type	Current	Voltage
Input Impendency	Medium	High

In bipolar transistors, the current flowing is in the form of *hole* and electron currents or in the form of majority and minority charge carriers. While the BJT (Bipolar Junction Transistor) of this type has two diodes whose positive or negative poles coincide, and has 3 terminals, namely *emitter* (E), *collector* (K), and *base* (B). BJT type transistors are divided into two types as follows.

- Transistor Type of NPN (Negative Positive Negative)

N and P in this type of transistor show the majority charge carriers in different areas of the transistor. The NPN transistor consists of a layer of P-type semiconductor between two layers of N-type semiconductor. A small current entering the *base* in the single emitter mode is amplified at the *collector* output. In other words, the NPN transistor turns on when the *base* voltage is higher than the *emitter* voltage. The arrow in the symbol is placed on the emitter pin and points out (the direction of conventional current flow when the device is forward-biased).

- Transistor Type of PNP (Positive Negative Positive)

The PNP transistor consists of a layer of N type semiconductor between two layers of P type semiconductor. The small current leaving the *base* in the single *emitter* mode is amplified at the *collector* output. In other words, a PNP transistor turns on when the *base* voltage is lower than the *emitter* voltage. The arrow in the symbol is placed on the emitter and it points inward.

- Relay

Relay is a device that works based on the following electromagnetic properties. Figure 2.4 shows the characteristics of Relay:

Figure 2.4 Relay (http://elektronika-dasar.web.id)

Relay is a device that works based on electromagnetic properties to move a number of arranged contactors or an electronic switch controllable from other electronic circuits by utilizing electric power as an energy source. The contactor will close (*lit*) or open (*off*) due to the magnetic induction effect produced by the coil (*inductor*) when an electric current is applied. Unlike the switch, the movement of the contactor (*on* or *off*) is executable manually without the need for an electric current.

The inventor of the first relay was Joseph Henry in 1835. In its use, relays driven by DC current are usually equipped with a diode in parallel with the windings and mounted upside down, namely the anode at voltage (-) and cathode at voltage (+). This aims to anticipate electric shocks that occur when the relay changes position from *on* to *off* so as not to damage the surrounding components.

The simplest relay is an electromechanical relay that provides mechanical movement when receiving electrical energy. In simple terms, definitions of this electromechanical relay are as follows.

- A device that uses electromagnetic force to close or open a switch contact.
- A switch that is mechanically driven by power or electrical energy.

As an electronic component, relays play an important role in an electronic circuit system and electrical circuit to drive a device that requires a large current without directly connecting to a controlling device having small current.

The relay consists of 3 main parts, namely:

a) *Common* is the part connected to *Normally Closed* (under normal circumstances).

b) *The coil* is a component of a type of switch where movement depends on a magnetic field, such as a coil of wire that gets an electric current to create a magnetic field.

c) *Contact* or *Connector* is a kind of switch where movement depends on the presence or absence of electric current in the *coil*. There are two types of contacts: *Normally Open* (the initial condition before activation opens), and *Normally Closed* (the initial condition before activation closes).

Figure 2.5 shows how the relay works:

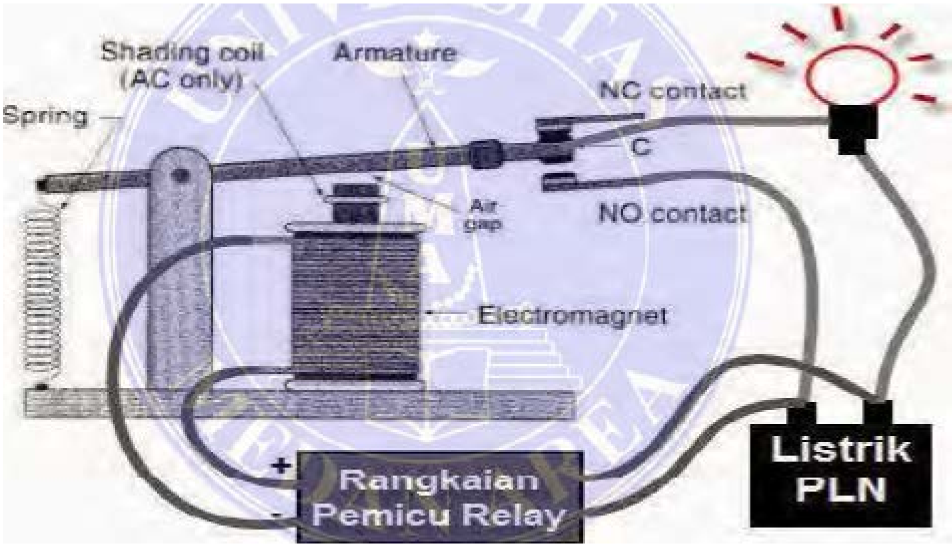

Figure 2.5 How the relay works (http://agamyusliman.blogspot.co.id)

a. When the coil gets electrical energy (*energized*), it will cause an electromagnetic force.
b. The magnetic force generated will attract the springing (*opposite*) contact plate/arm (*armature*), thus connecting 2 contact points.

Relay consists of several types. The types of relay include the following:

a. SPST (Single Pole Single Throw)
b. SPDT (Single Pole Double Throw)
c. DPST (Double Pole Single Throw)
d. DPDT (Double Pole Double Throw)

There are several purposes of using relays in electrical and electronic circuits, including the following:

a. To control a network.
b. To control a high voltage system, using a low voltage.

2.4. Motion Sensor or PIR (Passive Infrared Receiver).

Figure 2.6 shows the physical form of the Motion sensor (PIR.

Figure 2.6 the physical form of the motion sensor

(www.harisprasetyo.web.id)

PIR (*Passive Infrared Receiver*) is an infrared-based sensor. This sensor only responds to energy from passive infrared rays belonging to every object detected by it. Object detected by this sensor is usually the human body. The motion sensor with the PIR module is very simple and easy to apply because the PIR module requires a DC input voltage of 5 V, effective enough to detect movement up to a distance of 5 meters. When it does not detect motion, the module output is Low. When it detects movement, the output will change to High. The pulse width PIR (*Passive Infrared Receiver*) is an infrared-based sensor. This sensor only responds to energy from passive infrared rays belonging to every object detected by it. Object detected by this sensor is usually the human body. The motion sensor with the PIR module is very simple and easy to apply because the PIR module requires a DC input voltage of 5 V, is effective enough to detect movement up to a distance of 5 meters. When it does not detect motion, the module output is Low. When it detects movement, the output will change to High. The pulse width of the pyro-electric material acts to produce an electric current due to the heat energy under the passive infrared rays. When a human is in front of the PIR sensor with a silent condition, the PIR sensor will calculate the wavelength produced by the human body. This constant wavelength causes the produced heat energy to describe in almost the same way in the surrounding environmental conditions. When the human moves, the human body will emit passive infrared rays with varying wavelengths so that they produce different heat causing the sensor to respond by generating currents in the pyro-electric material of different magnitudes. It is because of these different quantities that the comparator produces output. Therefore, the PIR sensor will not produce output when this sensor faces with hot objects having no infrared wavelengths between 8 to 14 micrometers and stationary objects such as very bright lights capable of generating heat, reflections of objects from mirrors and hot temperatures during summer.

The motion sensor (PIR) consists of several parts as follows:

a. Fresnel Lens
b. Infrared Filter
c. Pyro-electric Sensors
d. Amplifier Booster
e. Comparator

Infrared rays enter through the Fresnel lens and hit the *pyro-electric* sensor, because infrared rays contain heat energy, the *pyro-electric* sensor will generate electric current. The *pyro-electric* sensor is made of gallium nitride (GaN), cesium nitrate (CsNo3), and lithium tantalate (LiTaO3). This electric current will cause a voltage and be read analogously by the sensor. Then this signal will be amplified by an amplifier and compared by a comparator with a certain reference voltage (the output is a 1-bit signal). So the PIR sensor will only output logic 0 and

1, 0 when the sensor does not detect infrared emission and 1 when the sensor detects infrared. PIR sensors are designed to only detect infrared radiation with a wavelength of 8-14 micrometers. Outside of these wavelengths, the sensor will not detect it. For humans, they have a body temperature that can produce infrared radiation with a wavelength between 9-10 micrometers (standard value 9.4 micrometers), this wavelength can be detected by the PIR sensor. (In general, PIR sensors are designed to detect Humans).

2.5. LM35 Temperature Sensor

The LM35 temperature sensor is an electronic component that has a function to convert the temperature scale into electrical quantity in the form of voltage. The LM35 temperature sensor used in this study is an electronic component produced by National Semiconductor. The LM35 has high accuracy and ease of design than other temperature sensors. It also has a low output impedance and high linearity so that it can easily connect to special control circuits and does not require further adjustment.

Although this sensor voltage can reach 30 volts, what is given to the sensor is 5 volts. Therefore, it can be used with a single power supply provided that the LM35 only requires a current of 60 A. It means that the LM35 has the ability to generate heat (*self-heating*) from the sensor causing a low reading error, which is less than 0.5 C at 25 C. Figure 2.7 shows the shape of the LM35 front view and bottom view:

LM35 Temperature Sensor

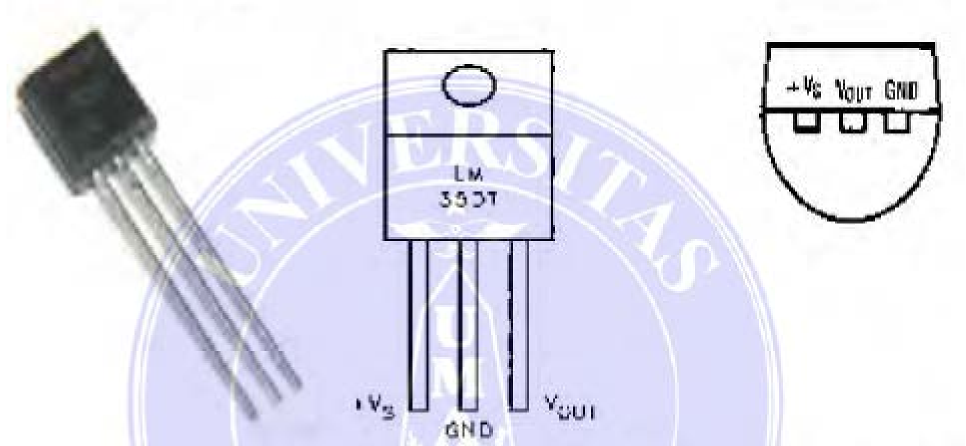

Figure 2.7LM35 Temperature Sensor (http://kusnantomukti.blog.uns.ac.id)

The picture above shows the shape of the LM35 front view and bottom view. The 3 pins of LM35 indicate the function of each of them. Pin 1 serves as a source of working voltage of LM35. Pin 2 or the middle is used as an output voltage or Vout with a working range from 0 Volt to 1.5 Volts with an operating voltage of the LM35 sensor that can be used between 4 Volts to 30 Volts. The output of this sensor will increase by 10 mV every degree Celsius so that the following equation is obtained:

V_{LM35} = Temperature* 10 mV

In principle, the sensor will sense when the temperature changes, every 1 ^{o}C temperature will show a voltage of 10 mV. In placement, LM35 can be attached with adhesive or can also be cemented on the surface but the temperature will be slightly reduced by about 0.01 ^{o}C because it is absorbed at the surface temperature. In this way, it is expectable that the the LM35 sensor can detect the difference between air temperature and surface temperature, equal to the surrounding temperature. If the surrounding air temperature is much higher or much lower than the surface temperature, then the LM35 is at the surface temperature and the surrounding air temperature.

Long distances require a connector that is not affected by external interference, so a grounded sheath cable is used so that it can act as a receiving antenna and the deviation therein, it can also act as a correcting current leveler in such cases, using the bypass capacitor method of Vin to be grounded. The following are the characteristics of the LM35 sensor.

a. Having temperature sensitivity, with a linear scale factor between voltage and temperature of 10 mVolt/ºC
b. Having a calibration accuracy of 0.5ºC at 25ºC
c. Having a maximum operating temperature range between -55 ^{o}C to +150 ^{o}C
d. Working on a voltage of 4 to 30 volts
e. Having a low current of less than 60 A
f. Having a low self-heating (low-heating) less than 0.1 ^{o}C in still air
g. Having a low output impedance of 0.1 W for a 1 mA load
h. Having a nonlinearity of only about ± ¼ ^{o}C

In principle, the sensor will sense when the temperature changes, every 1 ^{o}C temperature will show a voltage of 10 mV. In placement, LM35 can be attached with adhesive or can also be cemented on the surface but the temperature will be slightly reduced by about 0.01 ^{o}C because it is absorbed at the surface temperature. In this way, it is expectable that the

LM35 sensor can detect the difference between air temperature and surface temperature, equal to the surrounding temperature. If the air temperature around it is much higher or much lower than the surface temperature, then the LM35 is at the surface temperature and the air temperature around it is unaffected by external interference. Therefore, a grounded sheath cable is used so that it can act as a receiving antenna and the deviation in it can act as a correcting current leveler in such cases, using the bypass capacitor method from Vin to be grounded.

Therefore, it can be concluded that the working principles of the LM35 sensors are as follows:

a. The ambient temperature is detected using a temperature-sensitive IC section.
b. This ambient temperature is converted into electrical voltage by a circuit inside the IC, where the temperature change is directly proportional to the change in the output voltage.
c. In the LM35 series Vout = 10 mV/^{o}C Each 1 ^{o}C, each change will result in a 10Mv change in the output voltage.

Appropriate application is also useful for anticipating various things that might happen. In the design of an automatic fan based on temperature detection and human motion in this room, the LM35 temperature sensor and motion sensor (PIR) are used.

2.6. …

2.7. Diode

The word “diode” is a compound word meaning “two electrodes”. Where "*di*" means two and "*ode*" means electrode. Therefore, the diode is a two-layer N electrode (*cathode*) and a P layer (anode). Where N means negative and P means positive as shown in Figure 2.8 below:

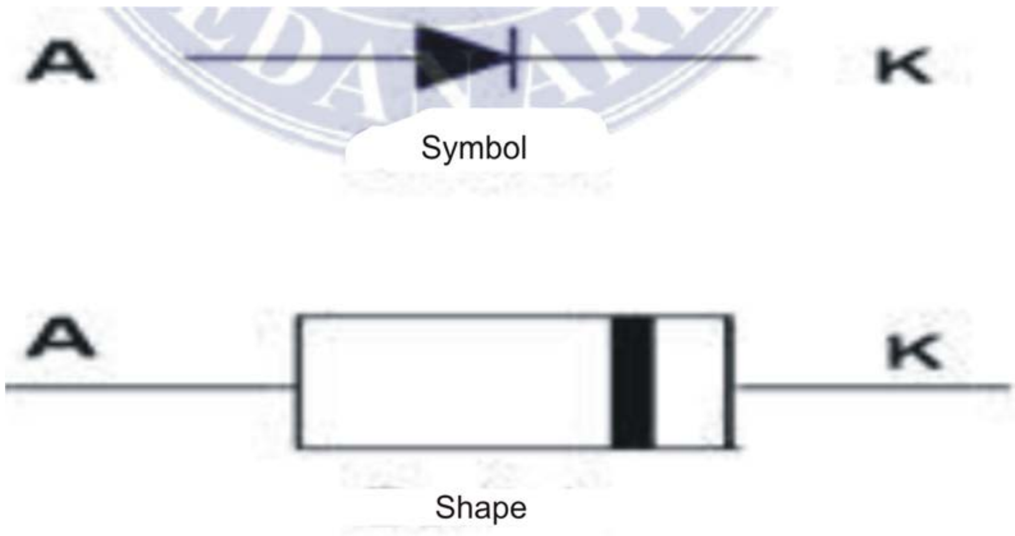

Figure 2.8 Diode Symbol (http://duniaelektonika.blogspot.co.id)

Diode is one type of electronic component that functions as a rectifier. Diode is made of silicon and germanium semiconductor materials. The diode is arranged using an "n" type semiconductor as the negative pole. The diode is an active component, the current flowing in through the P pin to the N pin will be continued if the voltage entered on the silicon diode is at least 0.7 volts and the germanium diode is at least 0.3 volts. Another function of the diode is as a switch in a low voltage range. One example is a silicon type diode. If the voltage is less than 0.7 volts, the voltage will not transmit.

2.7.1. Diode Working Principle

Almost all electronic appliances require a direct current source. Rectifier is used to get direct current from an alternating current. The current or voltage must be completely even and must not be pulsating so as not to cause interference to the supplied appliances. Semiconductor diodes can only pass current in one direction, that is, when the diode has a forward bias. Because, in the diode, there is a junction to which where the p-type semiconductor and n-type semiconductor meet. In this condition, it is said that the diode is in a conducting state and has a relatively small resistance in the diode. Meanwhile, if the diode is given a reverse bias, the diode does not work and, in this condition, the diode has a high internal resistance so that current is difficult to flow. If the silicon diode is powered by AC current, it only flows in one direction so that the diode output current is DC current. From these conditions, the diode is only used in a number of applications, including as a *Half Wave Rectifier*, *Full Wave Rectifier*, *Clipper*, *Clamper* and *Voltage Multiplier*. To understand how diode works, we can consider the following three situations:

a. Diode Given Zero Voltage

When the diode is given a zero voltage, there is no electric field that attracts electrons and the cathode. Electrons that experience heating at the cathode are only able to jump to a position not so far from the cathode and form a *space charge*. The inability of electrons to jump to the cathode is caused by the energy given to the electrons through heating by the heater not enough to move the electrons to reach the *plate*.

b. Diode Given Negative Voltage (*Reverse Bias*)

When the diode is given a negative voltage, the negative potential on the *plate* will repel the electrons that have formed a *space charge* so that the electrons will not be able to reach the *plate*, otherwise they will be pushed back to the cathode, so no current will flow.

c. Diode Given Positive Voltage (*Forward Bias*)

When the diode is given a positive voltage, the positive potential on the plate will attract electrons that have just been released from the cathode due to *thermionic* emission; in this situation, a new electric current will occur. How much electric current will flow depends on the amount of positive voltage applied to the plate. The greater the plate voltage, the greater the electric current will flow. Because of the nature of the diode like this, which can only flow electric current at certain voltage situations, the diode can be used as an electric current *rectifier*. In fact, the diode is widely used as a *rectifier* from AC voltage into DC voltage.

2.7.2. Types of Diodes

Diodes are divided into 2 types, including the following:

a. Common Diode

Common diode means a diode used in simple circuits and usually functions as a leveler or limiter of electric current. This common diode in operation can work when given an alternating or direct current electric current passing through the diode will partially pass either the positive voltage or the negative voltage depending on how it is installed. Common diode includes:

a. Silicone diode

b. Germanium diode

c. The rectifier diode

d. Selenium diode

e. Kuprok LED

f. Specific Diode

b. Specific Diodes

The function of this diode can flow in one direction. The function of this diode is generally to obtain electric current in one direction (called the *forward bias condition*) and to withstand current from the opposite direction (called the *backward long condition*). Therefore, the diode can be considered as an electronic version of the valve in fluid transmission where the valve will open if there is water flowing from the front to the back. Another function of the diode is as a rectifier and as an AC voltage signal to DC. *Half-wave rectifier* can also use a diode. But if you want to be a *half full rectifier*, you have to use 4 diodes arranged like a bridge or using 2 diodes with a transformer that has a center tap (CT). Specific diodes are:

a. Rectifier Diode

b. Zener Diode

c. Light emitting diode

d. Laser diode

2.8. Power Supply

Figure 2.9 shows a simple power supply circuit:

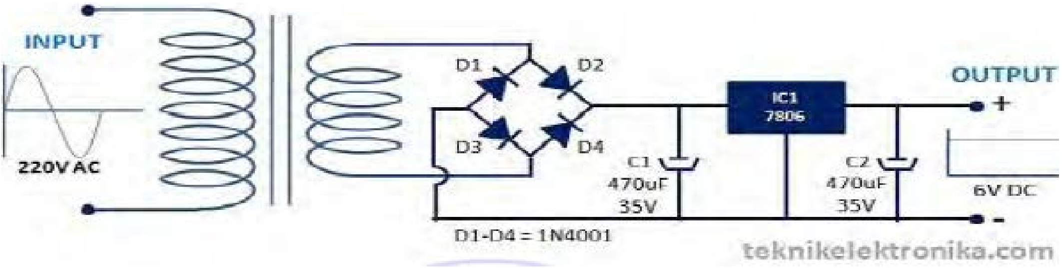

Figure 2.9 Power Supply Circuit (http://teknikelektronika.com)

Power supply or voltage source is a device or system that can generate electric current. The following are the types of power supply:

a. Source of Direct Current (DC)

Direct electric current is an electric current that has a constant value and flows from high potential (+) to low potential (-). The amount of direct electric current that we often find ranges from 1.5 to 24 volts. Direct current is commonly used in batteries, direct current dynamos, and accumulator. A direct voltage source is a voltage source that does not change with time.

b. Source of Alternating Current (AC)

Alternating electric current is an electric current with a magnitude and direction that varies back and forth. AC current flows back and front from high potential (+) to low potential (-) and from low potential (-) to high potential (+). In 1 second, AC current is alternating 50 to 60 times. Electrical waves in alternating current are sinusoidal, rectangular waves, or triangular waves. Examples of the use of alternating electric current are the PLN network and AC generators. If using PLN voltage, the alternating electric current ranges from 110 to 220 volts with a frequency of 50 Hertz.

The use of alternating current (AC) in the circuit is not done directly, but must first be converted into direct current (DC). The device used to convert alternating electric voltage into direct voltage is called an adapter. The adapter can output DC voltage of various values, from 1.5 to 12 volts, and can be increased as needed.

2.9. Fan

General function of fan is as an air conditioner, air freshener, ventilation (*exhaust fan*) and a general dryer that uses certain components. Figure 2.10 shows physical example of a fan:

Figure 2.10 Fan (suriptotitl.wordpress.com)

In general, the way the fan works is on the fan player driven by an electric motor. The working principle used is to convert electrical energy into motion energy. Electric motor consists of an iron coil in the moving part along with a pair of flat U-shaped magnets on the stationary (permanent) part. The electricity that flows in the coils of wire in the iron coil will make the iron coil become a magnet. Due to the nature of the magnets that repel each other at a pole, the repulsive force of the magnet between the iron coil and the magnet makes the force rotate periodically on the iron coil. As a result, fan blades attached to the coil shaft can rotate. The addition of electric voltage to the iron coil, which will become a magnetic force, is shown to increase the gust of wind on the fan.

All types of fans have the same way of working, the only difference being the position of the fan placement. The following types of fans are generally used in households.

a. Standfan

b. Deskfan

c. Wallfan

d. Orbitfan

a. The driving motor, the type of electric motor used is generally a split-phase induction motor, namely a capacitor motor. This motor has a main coil and a rock coil in series with the capacitor.
b. Fan, a propeller-shaped part that is one axis with the motor rotor. This propeller will rotate when the driving motor is operated.
c. Fan housing, rotating propeller guard, lattice or trellis.
d. Motor House, a holder for placing the motor from other components made of ebonite.
e. Stand or fan holder completed with speed control. This device serves to place the fan and its driving rotor, equipped with a speed control tool or button and a motor *on* or *off* button.
f. Body or casing, as a protector of the inner panels and elements.

In this section, there are usually switches and terminals for power cables.

The following are the secondary components of the Fan as follows:

a. Power cable, this cable usually consists of a plug for the power source and a plug contact for the terminal, so that electricity can enter.
b. Switch
c. Timer, a setting tool used to set the usage time
d. Spool or dynamo coil, as a magnet for driving a fan motor or propeller.
e. Rotor
f. Boost axle, where the propeller is installed.
g. Spool body or spool casing, mount or rotor drive motor housing.

h. Rotary motor, fan-directional drive

i. Propeller, serves to "blow" the air in the equipment to get out.

j. Propeller lock

2.10. AC Motor

Alternating current motors use an electric current that reverses its direction regularly over a certain period. An electric motor has two basic electrical parts: a "*stator*" and a "*rotor*" as shown in Fig. The stator is a component of static electricity. The rotor is a rotating electrical component to rotate the motor axle. The main advantage of a DC motor over an AC motor is that the speed of an AC motor is more difficult to control. To overcome this disadvantage, AC motors can be equipped with variable frequency drives to increase speed control while reducing power. Inductive motors are the most popular motors in the industries because of their reliability and ease of maintenance. AC inductive motors are inexpensive (half or less than a DC motor) and provide a high power-to-weight ratio (about twice that of a DC motor).

- Synchronous Motor

Synchronous motors are AC motors, working at a fixed speed at a certain frequency system. These motors require direct current (DC) for power generation and have a low starting torque, and therefore synchronous motors are suitable for low load starting applications, such as air compressors, frequency changers and motor generators. Synchronous motors are able to improve the power factor of the system, so that they are often used in systems that use a lot of electricity. The characteristics of the synchronous motor are shown in Figure 2.11 below:

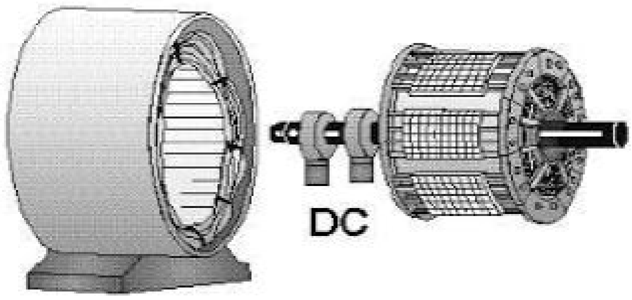

Figure 2.11 Synchronous Motor

Main components of Synchronous Motor:

a. Rotor

The main difference between a synchronous motor and an inductive motor is that the rotor of a synchronous machine runs at the same speed as the rotating magnetic field. It is possible that the rotor magnetic field is no longer induced. The rotor has a permanent magnet or DC-excited current, which is forced to lock in a certain position when facing another magnetic field.

b. Stator

The stator produces a rotating magnetic field proportional to the frequency supplied. This motor rotates at a synchronous speed, given by the following equation (Parekh, 2003):

$$N_s = 120\ f / P$$

Where:

f = frequency of supply frequency

P = number of poles

- Inductive motor

Inductive motors are the most commonly used motors in various industrial appliances. Its popularity is due to its simple design, cheap and easy to obtain, and can be directly connected to an AC power source. Inductive (induction) motors have two main electrical components:

1. Rotor

Induction motors use two types of rotors:

1) The squirrel cage rotor consists of thick conducting rods attached in a grid of parallel slots. The rods are short-circuited at both ends by means of short-circuit rings.
2) Rotor loop has three-phase, double-layer and distributed windings.

It is made circular as many as the stator poles. The three phases are wired on the inside and the other end is connected to a small ring attached to the shaft with a brush attached to it.

2. Stator

The stator is made of a number of stampings with slots to carry the three-phase windings. This scroll is looped for a certain number of poles. The rolls are spaced geometrically by 120 degrees as shown in Figure 2.12 below:

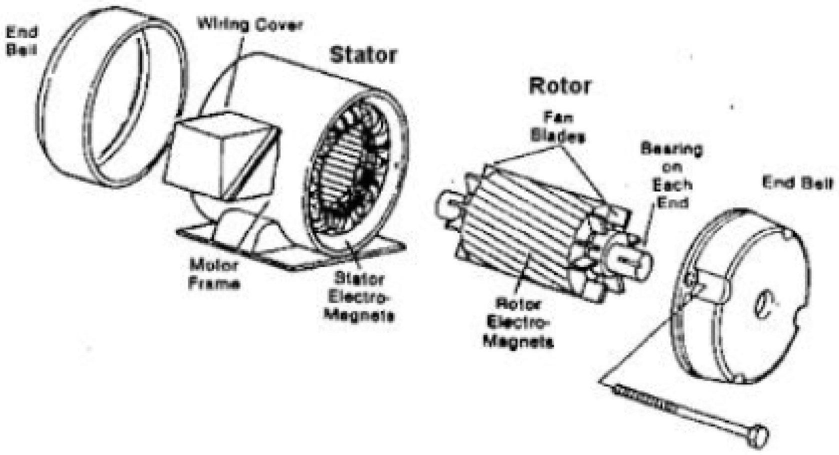

Figure 2.12. Induction Motor

Classification of Induction Motor

Induction motors can be classified into two main groups (Parekh, 2003): the first is single-phase induction motor. This motor has only one stator winding, operates on a single-phase power supply, has a squirrel cage rotor, and requires a device to start the motor. This motor is by far the most common type of motor used in household appliances, such as fans, washing machines, and clothes dryers, and for applications up to 3 to 4 hp. The second is three-phase induction motor. The rotating magnetic field is generated by a balanced three-phase supply. The motor is highly power capable, can have squirrel cages or rotor windings (although 90% have squirrel cage rotors); and self-ignition. It is estimated that about 70% of motors in industries use this type, for example, pumps, compressors, conveyor belts, power lines and grinders. These are available in sizes 1/3 to hundreds of hp.

Induction Motor Speed

The induction motor works as follows. Electricity is supplied to the stator generating a magnetic field. This magnetic field moves at synchronous speed around the rotor. The rotor current produces a second magnetic field, which attempts to counteract the stator magnetic field, which causes the rotor to rotate. However, in practice, the motor never operates at synchronous speed but at a lower "*base speed*". The difference between the two speeds is due to the "*slip*" that increases with the increasing load. *Slip* only occurs in induction motors. To avoid slipping, a slip ring can be installed, and the motor is called a "*slip ring motor*". The following equation can be used to calculate the percentage of *slip* (Parekh, 2003):

$$\% \, Slip = \frac{N_s - N_b}{N_s} \; x \; 100$$

Where:

Ns = synchronous speed in RPM

Nb = base speed in RPM

AC Motor Speed Setting

The initial temperature on this Ac motor speed setting is 27°C, which starts at speed one and will continue up to speeds two and three, having certain temperatures. The peak temperature of this fan is up to 100°C. There are three parts in setting the fan speed, regulated by a predetermined temperature, namely as follows:

a. At a temperature of 27°C, the fan rotation will be at speed one, starting from the initial temperature to 29°C and if the temperature is below the lowest temperature of 27°C, the fan will not turn on before the initial temperature is 27°C.
b. When the temperature starts to rise due to the indoor temperature starting from 29°C to 30°C, the temperature sensor will detect it and change the relay to move to the second speed position on the fan.
c. If there is an increase in the indoor temperature reaching 30°C towards the next temperature, the fan speed will increase and move to a maximum speed of three starting from 30°C to the maximum temperature specified in the design.

CHAPTER III

METHOD

3.1. Place and Time of Tool Design

The design of this tool was carried out at the Digital Basic Laboratory of the Electrical Engineering Study Program, Faculty of Engineering, located at Jalan Pond No. 1 Medan Estate. The final design was carried out starting from July 30, 2016 to August 30, 2016.

3.2. Flow Chart

The flowchart on how the tool works can be made using the flowchart shown in Figure 3.1 below.

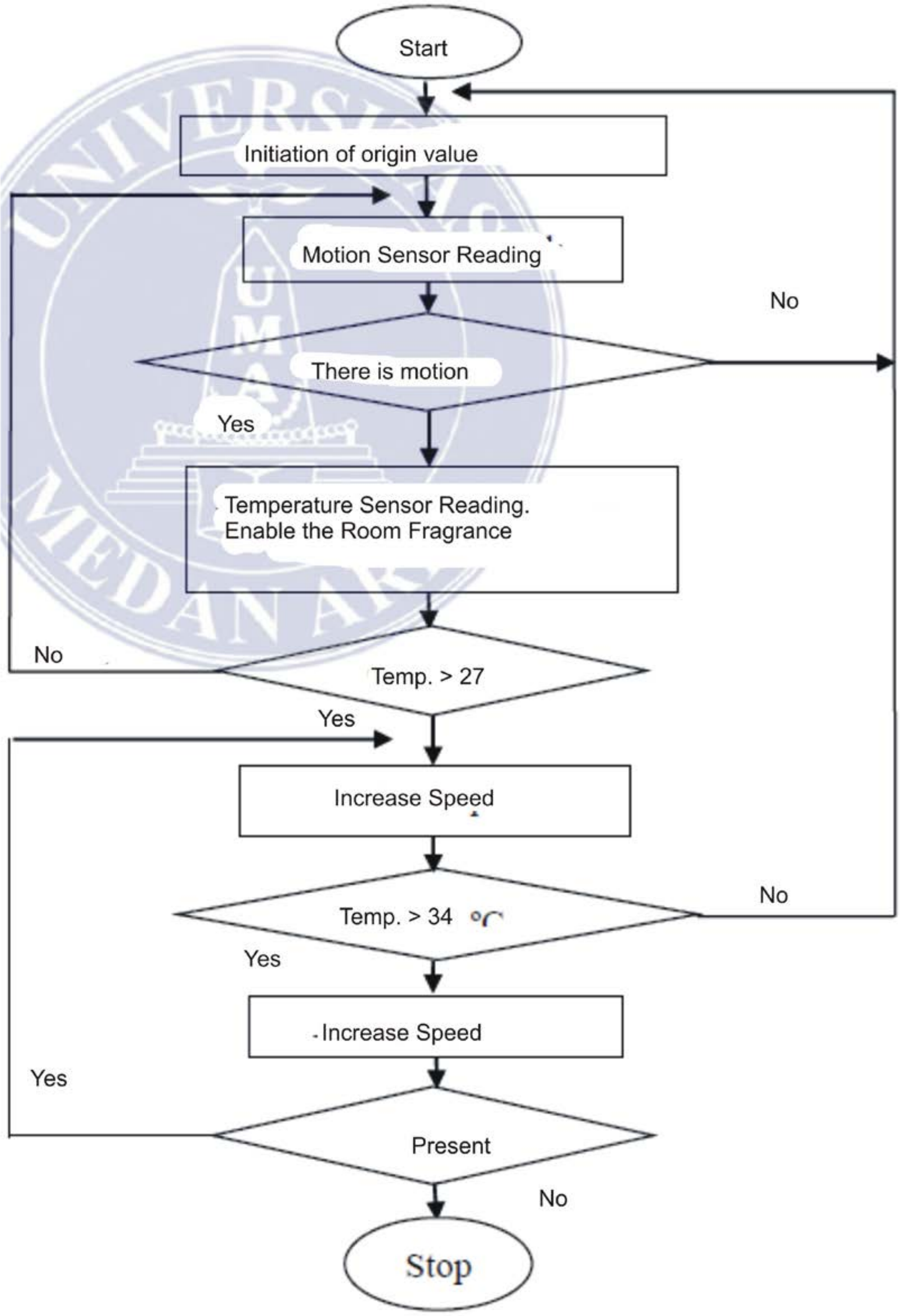

Figure 3.1. Flow Chart on How the Tool Works

3.3. System Circuit Design

The circuit design uses electronic and digital components working in accordance with their respective functions. Controller sensors and drivers work according to a designed program.

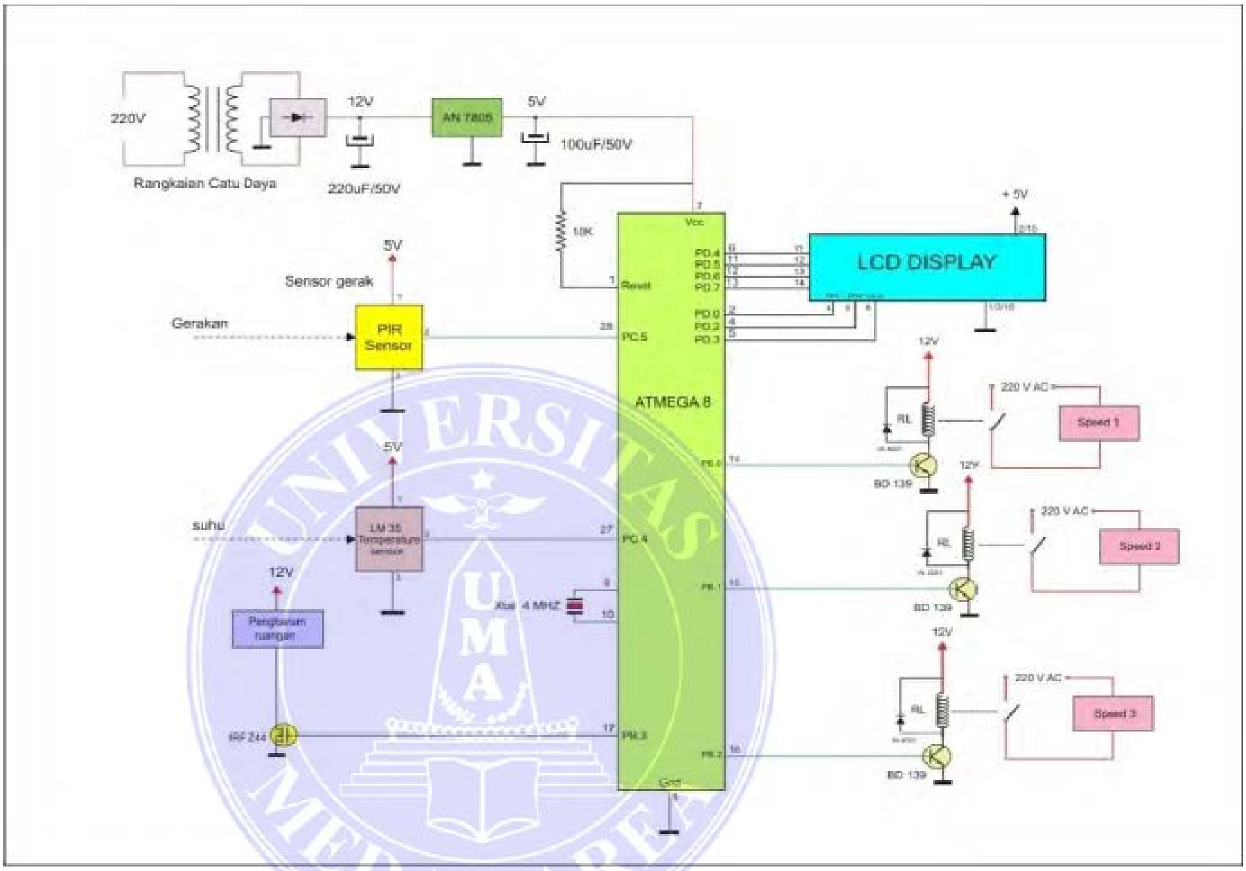

Figure 3.2 System Circuit

3.4. Method of data collection

The flowchart as shown above is a flow chart of tool design. The flowchart starts from the initialization and initial values then the process of reading the temperature and motion sensors through the input, when human movement is detected and the temperature in a room reaches

27ºC, it will simultaneously activate the system to run the Fan automatically. The methods used to obtain the data system are as follows:

a. Testing the Motion (movement) Sensor

In a design of tool, it is necessary to observe or test to obtain the desired results by measuring the sensor voltage output by providing input in the form of motion, namely the motion of small animals, humans and moving cars.

b. Testing the Temperature Sensor

Testing the temperature sensor is to raise the temperature sensor and measure the sensor output voltage using a voltmeter. Raising the temperature can bring the sensor closer to iron or soldering iron.

c. Measuring Spin Speed

To find out the fan speed, you only need to measure the fan rotation using a digital tool or device that can measure the rpm at the fan rotation. When the rotor rotates, it will be in accordance with the respective speed levels in the fan.

3.5. Block Diagram of Tool

The block diagram of the tool designed is a system configuration and system input and output. In this design, the system input is human motion and temperature in a room detected by the sensor and fed to an atmega8 microcontroller. The process carried out by the microcontroller is to verify sensor data and to activate the relay so that the system can run and the driver section functions as an amplifier. Therefore, the relay can activate. Figure 3.3 shows the block diagram that controls the system configuration.

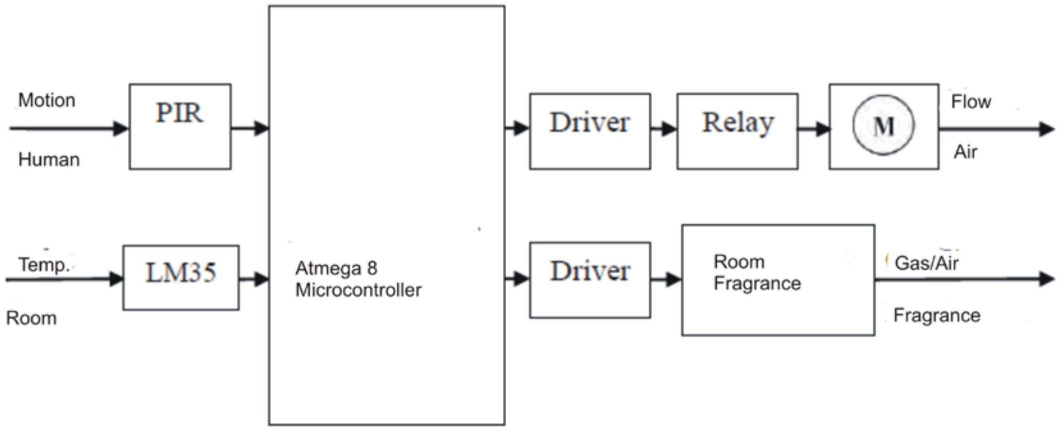

Figure 3.3 Block Diagram of Tool Design

The following is an explanation of the components and their functions in the design system of this tool:

a. PIR Sensor

The reading process of the PIR sensor is the process of reading human motion and as an input in the design of this tool.

b. LM35 Temperature Sensor

The reading process of the LM35 temperature sensor is the process of reading the temperature in a room and an input in the design of this device.

c. Microcontroller (NC)

The NC used is the AVR type, namely atmega8. The use of this selection because of the right size and the controller is quite reliable for this design. The NC is programmable to control a fan through motion detection, namely the PIR sensor. The NC also controls or sets the time for how long the fan activates after no motion is detectable.

d. Driver

The driver is an amplifier circuit that serves to amplify the current so that the system can activate the fan. The driver is in the form of a transistor circuit, namely NPN transistor of the TIP31C type. At the time of input, the transistor will saturate and flow current so that the load on the collector can run.

e. Relay

The relay activation process is the process of executing commands according to the detected conditions.

f. Room Fragrance

The design process of this tool is to combine air fragrance (freshener) in a fan designed so that a room does not produce unpleasant odors for human inhalation and will keep the air in the room cool and fragrant.

g. Fan Motor

The function of the fan motor is the main component in the design of this tool functioning to produce air that will flow to the human body when in the room.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

From the results of the design and testing of an automatic cooling device based on human motion under a microcontroller, the author can make several conclusions, namely:

1. The fan is controllable automatically by utilizing temperature and motion sensors detected by a microcontroller.
2. When the temperature sensor detects a temperature more than the specified capacity, the sensor will activate and send input to the relay moving the fan. If the temperature increases, the microcontroller will detect it so that it regulates the fan by increasing the fan speed automatically in the capacity of the fan engine.
3. Automatic fan control system uses temperature sensor and PIR sensor, quite easy to design and apply.
4. The control circuit is designed by using an atmega8 microcontroller and a program is necessary so that the controller can work.
5. The use of a microcontroller as a motor controller in the fan makes this tool easy to apply in daily needs.
6. Presence of humans can be detectable by a passive infrared sensor (PIR) that will detect changes in infrared light due to moving objects.

5.2. Recommendation

For further development, the author provides recommendations that may be very useful, including the following:

1. Because the detection range on the sensor is limited, it is expectable that other sensors can be usable.
2. It is expectable that it can create electronic materials such as other supporting components for purposes in electronic circuits.
3. For the application of this tool in daily needs, it is better to use another type of temperature sensor to detect the temperature more easily in a room.
4. In the future, it will be further developed to create an automatic fan design based on temperature detection and human motion in the room.

PROOFREADING

1.	Development	:	The development
2.	in	:	on
3.	applicable	:	applied
4.	question	:	The question
5.	A programming	:	programming
6.	technique	:	The technique
7.	usable	:	used
8.	electronic	:	An electronic
9.	explain	:	explains
10.	Specifically	:	Specifically,
11.	setting	:	set
12.	commonly	:	Is commonly
13.	data sheet	:	datasheet
14.	improvements in speed	:	speed improvements
15.	transistor	:	A transistor
16.	close	:	closed
17.	coil	:	The coil
18.	makes a movement	:	moves
19.	difference	:	The difference
20.	unaffected	:	Is unaffected
21.	Two layer	:	Two-layer