CONSTRUCTION AND IMPLEMENTATION OF HEAT SENSOR CONTROLLED ELECTRIC FAN

BY

MUSAH SARAH SULAIMAN

AST/2372051604

NOVEMBER, 2022.

CONSTRUCTION AND IMPLEMENTATION OF HEAT SENSOR CONTROLLED ELECTRIC FAN

BY

MUSAH SARAH SULAIMAN

AST/2372051604

A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF PHYSICAL SCIENCE LABORATORY TECHNOLOGY, SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY, AUCHI POLYTECHNIC, AUCHI EDO STATE.

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF HIGHER NATIONAL DIPLOMA (HND) IN PHYSICAL SCIENCE LABORATORY TECHNOLOGY, PHYSICS AND ELECTRONICS OPTION.

NOVEMBER, 2022.

CERTIFICATION

This is to certify that, the project work titled "Construction And Implementation Of Heat Sensor Controlled Electric Fan**"** by **MUSAH SARAH SULAIMAN** with **AST/2372051604** meets the regulations governing the award of the degree of Higher National Diploma (HND) Physical Science Laboratory Technology, Physics and Electronics Option of Auchi Polytechnic, Auchi and it's approved for its contribution to knowledge and literature presentation.

-- ---------------------------

MR. ESEKHAIGBE FRANCIS **Date**
(Supervisor)

-- **-------------------------**

MR. BRAIMAH JAFARU **Date**
(Head of department)

DECLARATION

I hereby declare that this project work was carried out by **MUSAH SARAH SULAIMAN** under the supervision of MR. **ESEKHAIGBE** F. of the department of physical Science Laboratory Technology, Auchi Polytechnic, Auchi. As part of the requirement of the award of Higher National Diploma (HND) in the School of Applied Science and Technology.

______________________________ ________________________

MUSAH SARAH SULAIMAN **Date**

DEDICATION

This project is dedicated to Almighty God for being by me all through the period of my study and granting me enablement to carry out this project in the course of my academic pursuit.

ACKNOWLEDGEMENT

My uttermost gratitude goes to God Almighty for His Grace, Wisdom, Knowledge, Mercy and Strength during the course of writing my project and throughout my academic pursuit.

My sincere appreciation goes to my project supervisor, **MR. ESEKHAIGBE F.** who despite with his tight schedules still took his time to read and make the necessary corrections.

I sincerely acknowledge the Head of the department physical science laboratory technology, **MR. BRAIMAH JAFARU** and to all the lecturers in the department of physical science laboratory technology, for their moral and individual support given to me during the course of writing this project.

My profound gratitude goes to my dad **MR. MUSAH SULAIMAN.** For His Nonstop support and prayers and to my late mum **MRS. MUSAH SEFIAT** may her soul continue to rest in peace.

And to my loving siblings I appreciate you all for your constant advice and support, may God continue to strengthen our bond.

I appreciate and value all the support of my friends and well-wishers may God bless you all.

TABLE OF CONTENTS

ABSTRACT

An automatic temperature controlled household electric ceiling fan is designed and developed in this research. The device uses a temperature sensor; a comparator unit and relay switch to automatically regulate the speed of the electric ceiling fan, creating breeze to enhance convective heat transfer. The developed household electric fan automatically changes speed in five different ascending levels with respect to the calibrated temperature range of the environment. The operation of this innovative device makes it suitable for users who may not be able to access the manual electric fan regulator. A sudden change in weather conditions affecting the ambient temperature might harm a person sleeping under a manually regulated fan. Depending on the temperature of the environment, the fan automatically regulates its speed, making the device safe and convenient. The circuit was attached to the controlling of the fan. The device is said to be particularly useful in health care facilities.

CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND OF STUDY

The word “heat” is made manifest as a result of increase in temperature, heat energy that is transferred from one body to another as the result of a difference in temperature (Encyclopaedia, 2017). A sensor is a device that produces an output signal for the purpose of sensing a physical phenomenon. In the broadest definition, a sensor is a device, module, machine, or subsystem that detects events or changes in its environment and sends the information to other electronics, frequently a computer processor. Sensors are always used with other electronics (Bennett, 2017*)*. Temperature is most often measured environmental quantities which correspond to primary sensations-hotness and coldness. This is due to the fact that most biological, chemical, electronic, mechanical and physical systems are affected by temperature (Zungeru, 2012). In many instances, some processes perform better within a range of temperatures. Also, certain chemical reactions, biological processes and even electronic circuits do better within limited temperature ranges. When the needs to optimize these processes arose, the systems used for controlling the temperature within defined limits are then needed.

The temperature sensors are often used in providing inputs to those control systems. However, in the case of too much exposure of some electronic components to high extreme temperature, there will be an advance effect on them which can lead to the damage of the components (Dincer, 2019). Though, some of the components can even be affected and get damaged by low temperature values. Semiconductor devices as well as LCDs (Liquid Crystal Displays) can be affected and get damaged by temperature extreme. As the temperature threshold gets exceeded, an immediate action should be taken so as to prolong the lifetime of the system. In these, temperature sensing helps to improve the reliability as well as the lifetime of the system.

The temperature sensor is probably one of the most popular and useful analog sensors in an embedded application. Essentially an analog temperature sensor converts the ambient temperature into a voltage reading, which can then be sensed by an analog pin of a microcontroller. The temperature sensor is great for applications that record and display temperature information such as a thermometer when you are sick, or the thermostat for your air conditioner.

However, heat energy that is transferred from one body to another as the result of a difference in temperature. If two bodies at different temperatures are brought together, energy is transferred—that is, heat flows—from the hotter body to the colder. The effect of this transfers of energy usually, but not always, is an increase in the temperature of the colder body and a decrease in the temperature of the hotter body. A substance may absorb heat without an increase in temperature by changing from one physical state (or phase) to another, as from a solid to a liquid (melting), from a solid to a vapour (sublimation), from a liquid to a vapour (boiling), or from one solid form to another (usually called a crystalline transition). The important distinction between heat and temperature (heat being a form of energy and temperature a measure of the amount of that energy present in a body) was clarified during the 18th and 19th centuries.

1.2. STATEMENT OF THE PROBLEM

A thorough observation has shown that sometimes the temperature of our homes can be intolerable especially during sunny days with less wind and cold days after heavy down pours. Both scenarios do create unbearable levels of temperatures. A device that can automatically track these temperature changes and appropriately control the speed of a fan to keep the temperature fairly constant with a selected range especially for those not having air-conditioning units will be very helpful in this regard (Theraja and Theraja, 2019). On cold days the speed of the fan will be low but will be high on sunny days. The work shows a typical temperature controller that are applicable in our homes and can be applied in bedrooms also or in any temperature control demanding environments..

1.3. PURPOSE OF STUDY:

The main purpose of the research work is to examine the construction and application of heat sensor. Other specific purposes of the study include:

- To determine the fundamentals of heat sensor
- To examine the components of heat sensor circuit
- To determine the favourable environmental condition for heat sensors

1.4. SCOPE OF THE STUDY:

The study on construction and application of heat sensor will cover the fundamentals of heat sensors and also the experimental effect of the application of the heat sensor.

1.5. SIGNIFICANCE OF STUDY

Today we have harnessed the power of the thermostat to not only simplify our life but also to make us more comfortable, increase efficiency, and save on electricity costs. Automated climate control systems for large diameter fans utilize thermostats. It help in controlling room temperature by adjusting fan to achieve the device by controlling the temperature of the system. It overcome the disadvantages of the thermostatic analogue system in terms of accuracy. It is used when it is important to maintain a precise temperature. It overcome the limitation of conventional control by not physically going near the switch on the button. The design controller may be employed for other slowly control variable. Below is other significance of the study.

1) No control adjustments
2) Optimized fan performance
3) It controls room temperature

1.6. LIMITATION OF THE STUDY:

Some of the limitation of the project work includes the following:

- Most of the materials needed for the construction of the heat sensors circuit are very expensive.
- Temperature sensors have their limited temperature range and low resistance to shock.
- The thermistor is not suitable for a large temperature range. The resistance temperature characteristics are nonlinear.

1.7. DEFINITION OF TERMS

1. **HEAT:** Heat is the amount of energy flowing from one body of matter to another spontaneously due to their temperature difference, or by any means other than through work or the transfer of matter.
2. **SENSOR:** A sensor is a device that detects and responds to some type of input from the physical environment
3. **FAN:** an apparatus with rotating blade that creates a current of air for cooling or ventilation.
4. **TEMPERATURE:** It is a physical quantity that expresses quantitatively the perceptions of hotness and coldness. Temperature is measured with a thermometer

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION TO THE STUDY

Heat sensors are found in many items, from common items inside any home to more sophisticated application. You can find sensor in house hold electronics like the thermostats or thermometer. You can also find sensors in things that are more sophisticated devices as your personal computer or in a microprocessor. It is vital for a processor to stay within the temperature specification to perform reliably and for the processor to run at its expected speed performance (Halim, 2011).

Temperature sensors are simple devices that sense the degree of cold or heat and transform it into a simple unit. But, do you ever think about how the temperature of the soil, land boreholes, great concrete dams, or houses is detected? Well, this is done by using some of the particular temperature sensors. We employ them in various applications in our daily lives, such as domestic water heaters, refrigerators, microwaves, or in the form of thermometers (Faris, 2009). Generally, they have a wide range of usages, and the geotechnical controlling area is one of them. They are utilized in this field to control the condition of concrete structures, bridges on soil or water, etc., for structural variations in them according to seasonal changes (Aigbokhan, 2015).

Temperature sensors are among the most commonly used sensors. All types of equipment use temperature sensors, including computers, cars, kitchen appliances, air conditioners, and (of course) home thermostats (Akpado et al., 2013). The five most common types of temperature sensors include: Thermistor, Thermocouple, RTDs, Analog thermometer ICs, and Digital thermometer ICs.

Most temperature monitoring devices are designed to respond to a particular (critical) temperature level. They are usually incorporated with different kinds of alarms and light indicator units, which are triggered ON at an unacceptable temperature level. These temperature monitoring devices work with temperature sensors normally transducers which generate accurate voltage output that varies linearly with temperature. They are mainly used for monitoring industrial machines, electric boilers, ovens and other heat energy related activities and this can be done by ensuring the temperature sensor and its leads are at the same temperature as the object to be measured. This usually involves making a good mechanical and thermal contact (Best-Microcontroller-Projects.com 2015).

If the temperature sensor is to be used to measure temperature in liquid, the sensor can be mounted inside a sealed end metal tube and can then be dipped into a bath or screwed into a threaded hole in a tank. Temperature sensors provide inputs to those control systems. When temperature limits are exceeded, action must be taken to protect the system. In these systems, temperature sensing helps enhance reliability (Kumar et al., 2013). In modern electronics, more temperature measuring techniques are available. Several temperature sensing techniques are in widespread usage.

The most common of these: Thermocouples, Thermistors and Sensor IC's. These temperature sensors ("transducers"), illustrate a nice variety of performance tradeoffs. Temperature range, accuracy, repeatability, conformity to a universal curve, size and price are all involved.

The Complementary Metallic Oxide Semiconductor (CMOS), which provides reasonable performance, is extensively used in the construction of this system. In previous research relating to temperature monitoring, transistor-transistor logic (TTL) integrated circuits were used. The TTL devices are attributed to high power consumption, limited logic functions, narrow power supply, low compatibility and high overall cost while CMOS on the other hand, provides low power consumption, good immunity to external noise, insensitivity to power supply variations, temperature range capabilities -48°C to 52CC (Denis, 2019).

In general, the most important characteristics of CMOS make it the logic of choice. A typical temperature monitoring device possesses both a temperature sensor and control unit that responds to the input. It is against this background that the study wishes to examine the construction and application of heat sensor.

2.2. CURRENT LITERATURE REVIEW

Temperature sensors are designed for temperature monitoring and analysis. These instruments either come equipped with integral temperature sensors, or require temperature sensor inputs. Temperature is the subject of such devices. The concerned sensors are the heart of the devices. The first recorded thermometer was produced by the Italian, Santorio (1561-1636) (Bean, 2020). As with many inventions the thermometer came about through the work of many scientists and was improved upon by many others. In a related work, Galileo Galilei (Park, 2018), invented another thermometer. However the instrument he invented was not able to carry the name thermometer, as to become a thermometer an instrument must be able to measure temperature differences.

The predecessor to the thermometer, the thermoscope is a thermometer without a scale, that is, it indicates differences in temperature only, that is to say that, it only shows if the temperature is higher, lower or the same, but unlike a thermometer it cannot measure the difference nor can the result be recorded for future reference. To add on, Gabriel Fahrenheit (Enescu, 2017) was the first person to make a thermometer using mercury. Fahrenheit used the newly discovered fixed points to devise the first standard temperature scale for his thermometer, and he divided the freezing and boiling points of water into 180 degrees, whereby 32 was the chosen as the reference value (the lower fixed point) as those produced a scale that would not fall below zero even when measuring the lowest possible temperatures that he could produce in his laboratory, a mixture of ice, salt and water. Though also, the Fahrenheit divided his scale into 100 degrees using blood temperature (incorrectly measured) and the freezing point of water as fixed points which is not true. The Fahrenheit scale is still in use today. While others are research done by Anders Celsius (1701-1744) Tomat, 2017), and Sir William Thomson (Tomat, 2017).

Any temperature measuring device is usually termed thermometer. Some of the recent work considers different approaches for automation and monitoring different system. The authors consider the use of infrared rays to count the number of passengers in a car and also remotely control home appliances via short message services for the purpose of security and human convenience.

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges (Fanger, 2019). Temperature is one of the most commonly measured variables and it is therefore not surprising that there are many ways of sensing it. Temperature sensing can be done either through direct contact with the heating source or remotely, without direct contact with the source using radiated energy instead (Arakawa, 2022). There are a wide variety of temperature sensors on the market today, including Thermocouples, Resistance Temperature Detectors (RTDs), and Thermistors.

2.2.1. TYPES OF TEMPERATURE SENSORS

- **Resistance Temperature Detectors (RTDs)**

Is a temperature-sensing device whose resistance changes with temperature? Typically built from platinum, though devices made from nickel or copper are not uncommon, RTDs can take many different shapes like wire wound, thin film. To measure the resistance across an RTD, apply a constant current, measure the resulting voltage, and determine the RTD resistance. RTDs exhibit fairly linear resistance to temperature curves over their operating regions and any nonlinearity is highly predictable and repeatable. The PT100 RTD evaluation board uses surface mount RTD to measure temperature. An external 2, 3, or 4-wire PT100 can also be associated with measure temperature in remote areas. The RTDs are biased using a constant current source. To reduce self-heat due to power dissipation, the current magnitude is moderately low. The circuit shown in the figure is the constant current source uses a reference voltage, one amplifier, and a PNP transistor.

Advantages or benefits of RTD:

1) Very stable output
2) Most accurate
3) Linear and predictable
4) High accuracy
5) High repeatability
6) Good precision

7) Low Drift

8) More linearity compare to a thermocouple

9) No special wire required for installation, easily install and update

10) It is available for in wide range

11) It can be used to measure differential temperature

12) No necessity of temperature compensation

13) Stability maintained over a long period of time

14) They are suitable for remote indication

15) Easy to verify and recalibrate

16) RTD does not require a special extension cable

Disadvantages or drawback of RTD:

1. High initial cost
2. Low sensitivity
3. It requires a more complex measurement circuit
4. Large bulb size
5. Low absolute resistance
6. Current source needed
7. Less rugged in a high vibration environment
8. A bridge circuit is needed with power supply
9. Shock and vibrations affect the reading
10. Point sensing is not possible
11. A circuit is little more complicated as it 34/4 wire measurement

12. Costlier as compared to other sensors like thermocouples

13. Slower response time than a thermocouple

14. More limited temperature range

15. Possibility of self-healing

16. Power supply failure can cause an erroneous reading

17. It can be avoided in industries for ranges above 650 deg. C

18. The RTD requires more complex measurement circuit

- **Sensor ICs**

There is a wide variety of temperature sensor ICs that are available to simplify the broadest possible range of temperature monitoring challenges. These silicon temperature sensors differ significantly from the above-mentioned types in a couple of important ways. The first is the operating temperature range. A temperature sensor IC can operate over the nominal IC temperature range of -55°C to +150°C. The second major difference is functionality.

A silicon temperature sensor is an integrated circuit, and can, therefore, include extensive signal processing circuitry within the same package as the sensor. There is no need to add compensation circuits for temperature sensor ICS. Some of these are analog circuits with either voltage or current output. Others combine analog-sensing circuits with voltage comparators to provide alert functions. Some other sensor ICs combine analog-sensing circuitry with digital input/output and control registers, making them an ideal solution for microprocessor-based systems.

The digital output sensor usually contains a temperature sensor, analog-to-digital converter (ADC), a two-wire digital interface, and registers for controlling the IC's operation. Temperature is continuously measured and can be read at any time. If desired, the host processor can instruct the sensor to monitor temperature and take an output pin high (or low) if the temperature exceeds a programmed limit. Lower threshold temperature can also be programmed and the host can be notified when the temperature has dropped below this threshold. Thus, the digital output sensor can be used for reliable temperature monitoring in microprocessor-based systems.

The above temperature sensor has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that operates according to temperature to vary the resistance. This change of resistance is sensed by the circuit and it calculates the temperature. When the voltage increases then the temperature also rises. We can see this operation by using a diode.

Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need for A/D converters.

2.2.2. Temperature Control System

A control system consists of controller and plant, and requires an actuator to interface the plant and controller. The behavior and performance of a control system depend on the interaction of all the element (Yudhajit Das, 2013).There are two common classes of control systems, open loop control systems and closed loop control systems. In open loop control systems output is generated based on inputs. In closed loop control systems current output is taken into consideration and corrections are made based on feedback. A closed loop system is also called a feedback control system (as in case of the temperature controller).

In the case of linear feedback systems, a control loop, including sensors, control algorithms and actuators, is arranged in such a fashion as to try to regulate a variable at a set point or reference value. An example of this is decreasing the temperature of a room when the room gets hot using an air conditioning system. PID controllers are common and effective in cases such as this. Control systems that include some sensing of the results they are trying to achieve are making use of feedback and so can, to some extent, adapt to varying circumstances.

- **On-Off Control**

A thermostat is a simple negative feedback controller: when the temperature (the "process variable" or PV) goes below a set point (SP), the heater is switched on. Another example could be a pressure switch on an air compressor. When the pressure (PV) drops below the threshold (SP), the pump is powered. Refrigerators and vacuum pumps contain similar mechanisms operating in reverse, but still providing negative feedback to correct errors.

Simple on off feedback control systems like these are cheap and effective. In some cases, like the simple compressor example, they may represent a good design choice. In most applications of on off feedback control, some consideration needs to be given to other costs, such as wear and tear of control valves and perhaps other start-up costs when power is reapplied each time the PV drops. Therefore, practical on off control systems are designed to include hysteresis which acts as a dead band, a region around the set point value in which no control action occurs. The width of dead band may be adjustable or programmable.

- **Linear Control**

Linear control systems use linear negative feedback to produce a control signal

mathematically based on other variables, with a view to maintain the controlled process within an acceptable operating range (Wikipedia, 2015). The output from a linear control system into the controlled process may be in the form of a directly variable signal, such as a valve that may be 0 or 100% open or anywhere in between. Sometimes this is not feasible and so, after calculating the current required corrective signal, a linear control system may repeatedly switch an actuator, such as a pump, motor or heater, fully on and then fully off again, regulating the duty cycle using pulse-width modulation.

- **PID Control**

The temperature sensor converts change in temperature to change in electrical signal which is then compared by the PID controller control algorithm to activate the fan for the cooling of the system. The microcontroller accepts inputs from a simple four-key keypad which allow specification of the Set point temperature and it displays both set-point and measured chamber temperatures using an LCD display. Finally, a pulse-width modulation (PWM) output from the controller is used to drive a relay which switches the fan off and on.

2.2.3. The First Automated Temperature Controller

The Automatic Temperature Control System was named as a Historic Mechanical Engineering Landmark in 2008. Warren S. Johnson came up with the idea for automatic temperature control while teaching at Normal School in Whitewater, Wisconsin in the 1880's. Originally, janitors would have to enter each classroom to determine if it was too hot or cold and then adjust the dampers in the basement accordingly. Johnson sought a way to end, or at least minimize the classroom interruptions of the janitors and increase the comfort level of the students. The Automatic Temperature Control System would do just that. In 1883 Warren Johnson gave up teaching to fully devote his time to researching and developing his ideas. He moved to Milwaukee and formed the Johnson Electric Service Company in 1885. In 1895, Johnson patented the pneumatic temperature control system. This allowed for temperature control on a room by room basis in buildings and homes. It was the first such device of its kind. By the early 20th century the Automatic Temperature Control System was being used in many notable places including the New York Stock Exchange, Palaces of Spain and Japan, WestPoint, the Smithsonian, the US Capitol Building, and the home of Andrew Carnegie.

Back in 1895 the Automatic Temperature Control System outlined the same design principles used in modern day temperature and climate control systems. A design that sustains relevance for over 100 years must be a true engineering marvel. The Automatic Temperature Control System established a great reputation for Johnson Controls. Even in the present day, Johnson Control sex hibits the enduring legacy of Warren Johnson and his inventions through its 140,000 employees and services evident in 200 million vehicles, 12 million homes, and 1 million commercial buildings

2.2.4. Applications of Temperature Sensor

Temperature sensors are all around us, monitoring temperature is a vital process in many fields and needs to be measured in a highly accurate and efficient way. Some temperature sensor applications are;

- **Motorsport and other vehicles** – within motorsports there are many temperature sensor applications. These include; ensuring motors do not overheat surface plate temperature, exhaust gas temperature, oil temperature etc.

- **Medical Applications** – Temperature sensors are used for patient monitoring as well as within machines and devices for a range of medical procedures. To be used in these industry temperature sensors will require various safety standards and approvals.
- **Food and Beverage Industry** – temperature sensors are used within this environment as part of food safety standards, ensuring food is kept at the correct temperature. They are also used on various manufacturing equipment used within this sector.
- **Home appliances and white goods** – many appliances within the home will contain a temperature sensor; oven, toaster, kettles, washing machines, coffee machines, dishwashers, electric radiators, boilers etc.
- **Computers and devices**– temperature sensors are used within computers and other devices to ensure they do not overheat and become dangerous.

More temperature sensor applications and areas:

- Transit – refrigerated vans and lorries
- HVAC – Heating Ventilation and Air Conditioning
- Power and Utilities
- Heat Exchangers
- Laboratory and testing applications

2.3. SUMMARY OF THE CHAPTER:

This chapter reviewed various journal papers on construction and application of heat sensor. It contains the various places in which the heat sensors can be used include: our house hold electronics and other sophisticated devises as our personal computer. The most common of these sensors include: Thermocouples, Thermistors, and Sensor IC's. The various application of the heat sensor was also explained in this chapter.

After construction, the circuit was attached to the control of a standing fan using a gum with the part containing the temperature sensor exposed so as to be able to detect changes in the temperature of the environment.

CHAPTER THREE

RESEARCH METHODOLOGY

3.2. Working Principles of a heat sensor control electric fan.

The working principle of a heat sensor control electric fan is very simple: solder the microcontroller to the Vero board, connect the temperature sensor (LM35) to the micro controller connect the transistor to the micro controller and the dc fan connect the switch between the circuit and the battery position. Upload program to the micro controller. Power on the board, test with the heat source and arrange the circuit in a casing

Fig. 3.1: Image of the heat sensor with electric fan

3.5. Circuit design and procedure

Below is the circuit diagram of a heat sensor controlled electric fan.

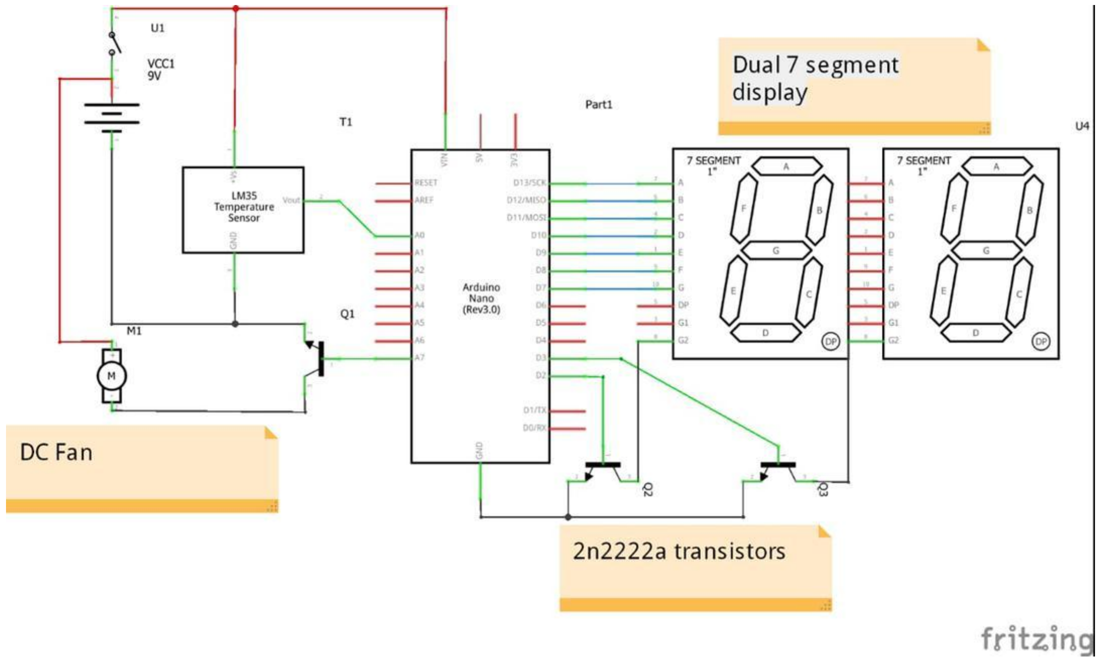


Fig. 3.2: Circuit diagram

3.6. Construction and testing

After construction, the circuit was attached to the control of a standing fan using a gum with the part containing the temperature sensor exposed so as to be able to detect changes in the temperature of the environment. The control of the fan was disabled since it has become irrelevant. The fan was then connected to a power source. A slight delay was experienced as the temperature sensor took a short time to read the temperature of the surrounding. After the short delay the fan started working. To alter the temperature of the environment, a hot material was brought close to the temperature sensor and it was observed that the fan speed was fluctuating as seen by changes in the colour of light emitting diode (LED). It was observed that the closer the hot material was to the temperature sensor, the higher the speed of the fan and vice-versa.

3.7. Component and materials used

The following are the component used for the construction:

1. Ardrino
2. LM37 Temperature sensor
3. DC fan
4. Dual seven segment display
5. Resistor
6. 9v battery
7. Transistor 2N222A
8. Vero board
9. Casing

3.7.1. Arduino

An Arduino program is used to program the microcontroller based on the desired function. The arduino is an open source project that creates microcontroller based kit for building digital device and interactive objects that can sense physical quantities and control devices. The project is based on micro controlled board design, produced by several vendors using various microcontrollers. These systems provide sets of digital and analog input/output (I/O)pins that can interface with various expansion boards and other circuits. The board features a serial communication interface or a universal serial bus (USB) on some models, for loading program from personal computers to program the microcontrollers. The Arduino project provides an integrated development environment (IDE) based on both the C and C# languages. The first Arduino program was introduced in 2005 aiming to provide a low cost, easy way for novice and professionals to create devices that interact with their environment using sensor and activators. In this work, it was used to program the microcontroller on what to do at a certain temperature. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

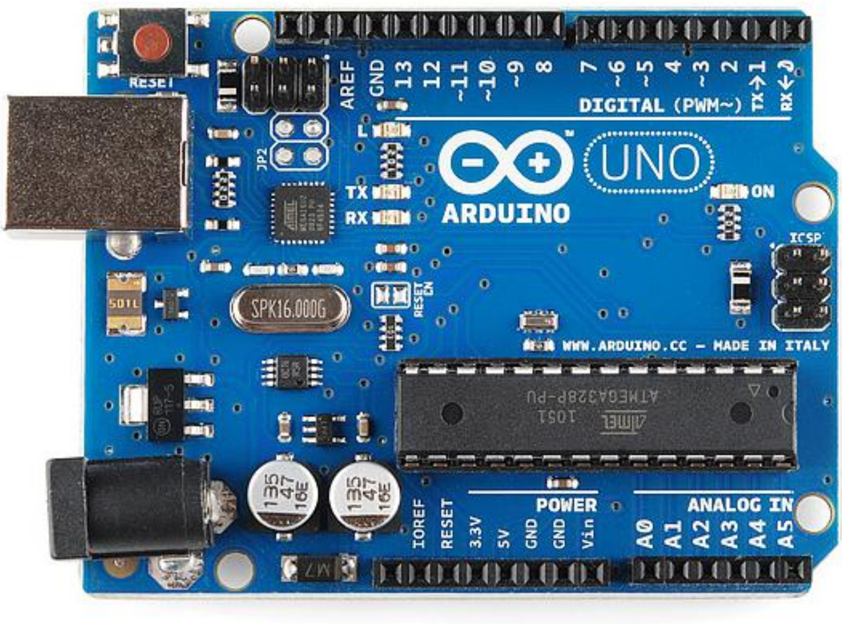


Fig. 3.3: Image of an Arduino

3.7.2. LM37 Temperature sensor

The LM35 device is **rated to operate over a −55°C to 150°C temperature range**, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). **LM35** is an analog, linear temperature sensor whose output voltage varies linearly with change in temperature. LM35 is three terminal linear temperature sensors from National semiconductors. It can measure temperature from***-55 degree celsius to +150 degree celsius.*** The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55C to 150C. Power the IC by applying a regulated voltage like +5V (V) to the input pin and connected the ground pin to the ground of the circuit.

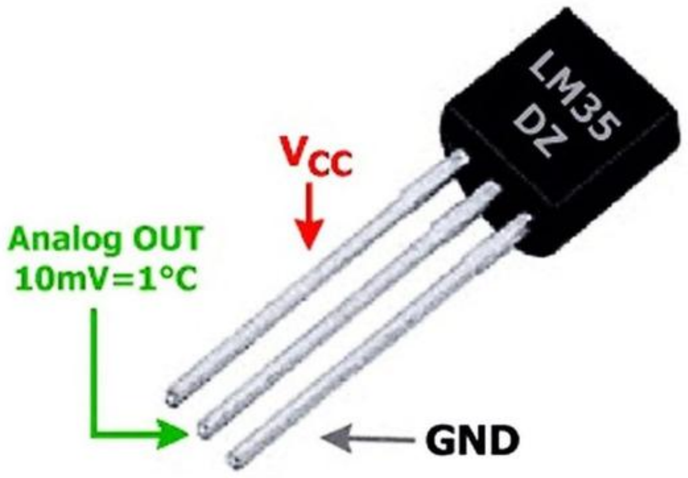


Fig. 3.4 Image of Temperature Sensor

3.7.3. Dc fan

A DC, or direct current fan, uses a power source that is connected to a transformer. The transformer then converts the energy to direct current, or a one-way current. As a result, the quantity of power utilised is ultimately decreased. DC fans are becoming increasingly common, and they offer the benefit of delivering a high level of efficiency. In fact, a DC motor will consume as much as 70% less energy than its AC counterpart will.

Fig. 3.5: Image of a DC fan

3.7.4. Dual seven segment display

This is not your basic 7-segment display. The Dual 7-Segment Display features two digits with an RGB LED in every single segment! You will now have a small 7-segment LED in your project with a full-color display! The Dual 7-Segment Display is breadboard friendly and possesses a digit height of 0.56in (14.22mm). The red LEDs have a forward voltage of 2VDC, 2.85VDC for green, and 2.95VDC for blue, with a continuous forward current per segment of 10mA for the red LEDs and 5mA for the green and blue. The *7-segment display*, also written as “seven segment display”, consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed.

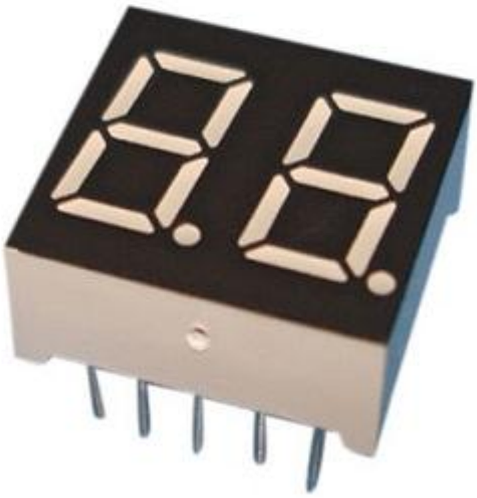


Fig. 3.6: Image of dual seven segment display

3.7.5. Resistor

Resistors are used in virtually all electronic circuits and many electrical ones. Resistors, as their name indicates resist the flow of electricity, and this function is key to the operation most circuits.

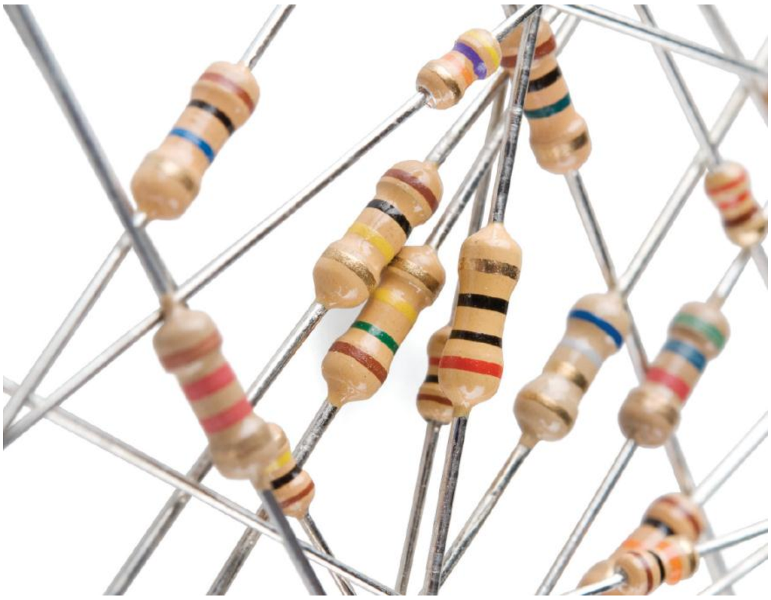


Fig. 3.7: Image of a resistor

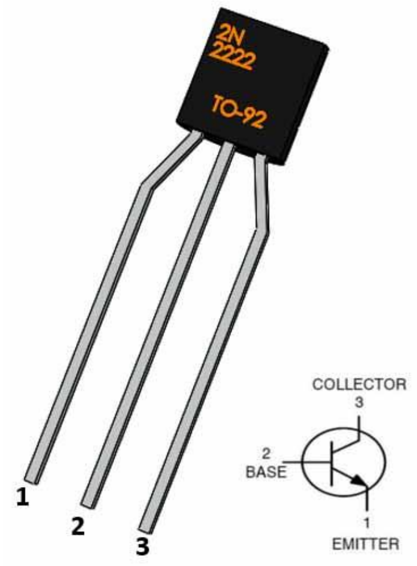
3.7.6. 9v batter

The nine-volt battery, or 9-volt battery, is an electric battery that supplies a nominal voltage of 9 volts. Actual voltage measures 7.2 to 9.6 volts, depending on battery chemistry. Batteries of various sizes and capacities are manufactured; a very common size is known as PP3, introduced for early transistor radios. The PP3 has a rectangular prism shape with rounded edges and two polarized snap connectors on the top. The nine-volt PP3-size battery is commonly available in primary zinc-carbon and alkaline chemistry, in primary lithium iron disulfide and lithium manganese dioxide (sometimes designated CRV9), and in rechargeable form in nickel-cadmium (Ni–Cd), nickel-metal hydride (Ni–MH) and lithium-ion. Mercury batteries of this format, once common, have been banned in many countries due to their toxicity.

Fig. 3.8: Image of a 9v battery

3.7.7. Transistor 2N222A

2N2222A is a NPN transistor hence the collector and emitter will be left open (Reverse biased) when the base pin is held at ground and will be closed (Forward biased) when a signal is provided to base pin. 2N2222A has a gain value of 110 to 800; this value determines the amplification capacity of the transistor. The maximum amount of current that could flow through the Collector pin is 800mA, hence we cannot connect loads that consume more than 800mA using this transistor. To bias a transistor we have to supply current to base pin, this current (I_B) should be limited to 5mA. When this transistor is fully biased, then it can allow a maximum of 800mA to flow across the collector and emitter.



2N2222A	
1	Emitter
2	Base
3	Collector

Fig. 3.9. Image of a transistor

3.7.8. Veroboard

Veroboard is a brand of stripboard, a pre-formed circuit board material of copper strips on an insulating bonded paper board used to make electronic circuits, where some of the electrical connections are formed by strips of copper on the underside of the board. Veroboard is a printed circuit board that's designed with rows of copper tracks with holes drilled in then for electronic components to be soldered to construct electronic circuits. It is characterized by a 0.1 inch regular grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. The 0.1 inch (2.54 mm) spacing allows sockets for ICs. The components are usually placed on the plain side of the board, with their leads protruding through the holes. The leads are then soldered to the copper tracks on the other side of the board to make the desired connections, and any excess wire is cut off. The continuous tracks may be easily and neatly cut as desired to form breaks between conductors using a 5 mm twist drill, a hand cutter made for the purpose, or a knife.

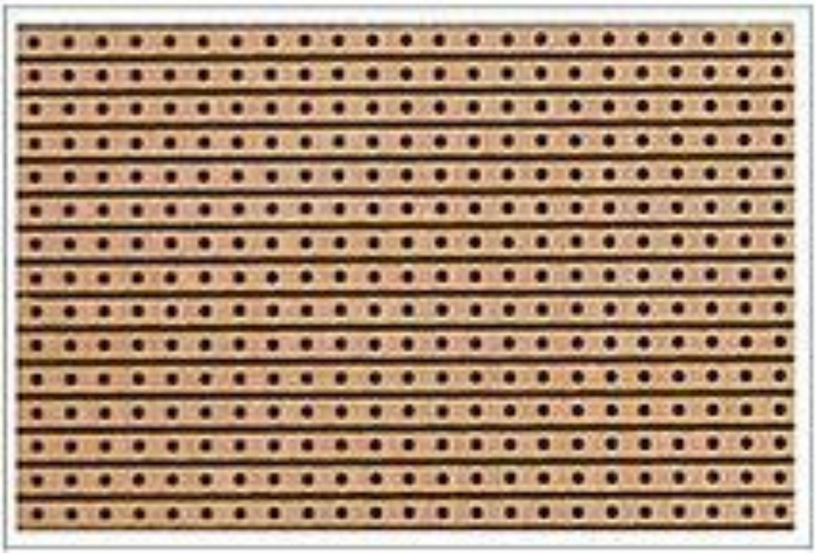


Fig. 3.10: Vero board

3.7.9. Casing

The casing was made of white rubber casing for system wiring. The full material was cut into size to fit the circuit. The rubber casing was chosen to enable ease of handling while making holes, screwing, and to serve as insulation for the circuit. The tools used for the construction of the casing include; a soldering iron for punching holes through the casing and a screwdriver was used for bolting the parts together.

CHAPTER FOUR
RESULT AND DISCUSSION

4.3. TESTING OF SYSTEM OPERATION

The main reason for testing all the components before they were finally soldered on the Vero board is to avoid the painstaking effort it will take to dis-solder faulty components at the end of the day. From the continuity test carried out on the Vero-board to check the circuit path, it was discovered that the circuit was in a perfect working condition as continuity was ensured.

The control of the fan was disabled since it has become irrelevant. The fan was then connected to a power source. A slight delay was experienced as the temperature sensor took a short time to read the temperature of the surrounding. After the short delay the fan started working. To alter the temperature of the environment, a hot material was brought close to the temperature sensor and it was observed that the fan speed was fluctuating as seen by changes in the colour of light emitting diode (LED).

4.4. **Discussion of result**

After the testing of the heat sensor control system of the electric fan, It was observed that the closer the hot material was to the temperature sensor, the higher the speed of the fan and farther the hot material was to the temperature sensor, the slower the speed of fan.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

It can be concluded that the sole aim of carrying out the construction and implementation of heat sensor control of electric fan system was achieved, in that the aim was to develop a cheap, affordable, reliable and efficient temperature monitoring device, which was successfully realized at the end of the design process.

The goal of this work was to construct a circuit that will automatically control the speed of a fan according to changes in the temperature of the surrounding. The circuit was constructed with the use of a Vero board on which all other components used were attached. The circuit was then attached to the control of a standing fan and was tested. The outcome of the test showed that our fan worked perfectly well as the speed of the blades was notice to change with changes in temperature. Based on this, I conclude that the effort has been a success.

5.2. RECOMMENDATION

A temperature controlled fan can be used in environments like hospitals, industries, offices and elderly peoples' homes. It is particularly useful in health care facilities since there are patients whose need for airflow is temperature dependent and may also find it stressful to manually adjust fan speed.

REFERENCE

Aigbokhan, W. H., (2015). Electronic Components and Systems, Butterworth and Company Limited, England.

Arakawa, C., (2022). Uses and important of heat sensor, Available at: http://energyquest.ca.gov/scientists/celsius.html

Akpado, S. et al ., (2013). A brief history of the clinical thermometer.QJM: *International Journal of Medicine, 95(4), pp. 251-252. International*

Bean, B., (2020). The history of the Thermometer.About.com Guide. Available at:[http://inventors.about.com/od/tstartinventions/a/History-Of-The Thermometer.htm](http://inventors.about.com/od/tstartinventions/a/History-Of-The-Thermometer.htm)

Bennet (2017), "Design of automatic- temperature-control circuit module in tunnel microwave heating system," In Proceedings of the IEEE *International Conference on Computational and Information Sciences, pp. 1216-1219.*

Dincer (2019)," Automatic Fan Speed Control System Using Microcontroller ",6th Int'l Conference on Electrical, Electronics & Civil Engineering (ICEECE'2014) Nov. 27-28, 2014 Cape Town (South Africa)

Encyclopaedia (2017), Automatic room light intensity detection and control using a microprocessor and light sensors. IEEE Transactions on Consumer Electronic, 1173.

Enescu J.K. (2017). Design and Implementation of a Low Cost Digital Bus Passenger Counter.Innovative Systems Design and Engineering, 3(4), pp. 29–41.

Faris, J.P. (2009); Control Systems Engineering, 2nd Ed., pp. 1-3.

Fanger, I. (2019).A Simple and Reliable Touch sensitive security System. *International Journal of Network Security & Its Applications (IJNSA), 4(5), 149–165.*

Halim G. A. (2011), “Automatic Street Light Control System Using Microcontroller,” 1st International Conference on Machine Design and Automation, Turkey pp. 92-96.

Kumar U. K. Galileo, G., (2013). The Galileo project: The Thermometer. Available at: http://galileo.rice.edu/sci/instruments/thermometer.html *Journal of Instrumentation and Control Systems (IJICS) Vol.2, No.4, October 2012*

Park, C., (2018). Super Scientist. California Energy Commission, Available at: http://energyquest.ca.gov/scientists/celsius.html

Theraja T.Y. (2019), "Design and implementation of microcontroller based automatic fan speed regulator (using temperature sensor) *"International Journal of Engineering Research And Management (IJERM), Volume-01, Issue-05*

Tomat, I. K. (2017). Design and Implementation of a Short Message Service Based Remote Controller. Computer Engineering and Intelligent systems, 3(4), 106–118.

Zungeru (2012), “The Design Of Temperature Control System Using Pic18f46201,” ICSTC, PP 282−286.