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# DESIGN AN AUTOMATIC TEMPERATURE CONTROL SYSTEM FOR SMART TUDUNG SAJI USING ARDUINO MICROCONTROLLER

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## ABSTRACT

This paper presents an innovative design of a prototype TudungSaji that involves both hardware and software development. This project is designed an effective TudungSaji is able to maintain the food warm and to protect food from pests like flies and rats. Smart TudungSaji uses an Arduino microcontroller to produce an automated function. The main parts of this project consist of chassis, 2 sensors which are temperature sensor LM35 and limit switch sensor as an inputs, the ATmega328p microcontroller and 2 bulbs as an outputs. This is to ensure the warming process operates more efficiently and effectively. The algorithm is developed and implemented with Arduino Uno. It is really practical for human, especially working woman to make their life simpler. This project helps people to keep their food warm and it is portable to bring anywhere. The performance of this project was validated with the simulation circuit using Proteus 6 Lite, and the results and findings from conducting experiments on the prototype. The bulbs are activated by the LM35 sensor detected temperature below 60$^{o}$C.Then, the bulbs will automatically off when temperature reaches upper 60$^{o}$C.This project uses 240V 100W bulb as a heating element. It can be improvised by replacing bulbs with thermistor coil. The thermistor coil can produce more heat energy because of the material of the coil, for example in the oven.

**Keywords:** ATmega328P microcontroller, LM35 sensor, arduino, temperature, proteus 6 lite.

## INTRODUCTION

A traditional TudungSaji is a food cover which mostly used by the Malays to cover their foods. Nowadays, the usage of TudungSaji is used to prevent food from the flies and rat. But unfortunately, it cannot maintain the temperature of the food. In theory, the quality of food must be always warm. To ensure the freshness of the food is better, it must keep the temperature around the food. Based on this problem, there are an ideal to create an automatic temperature control system technology to replace the traditional TudungSaji. Based on this problem, there is an idea to create an automatic temperature control system technology which applied to the traditional TudungSaji to become innovative, more effective and useful.

A field of study to make an innovative TudungSaji was applied concept of an automatic temperature control system technology. Today, many researchers focusing on an automatic temperature control system application in different fields will gain the benefits. For example, application of PID Control and implementation of continuous PID controller in Siemens PLCs [1], an automatic temperature control system for smart fan [2], automatic temperature controller designing a data logger for a slow cooker [3],automatic room temperature control by using Fuzzy Logic Control (FLC) [4], design of automatic temperature control circuit module in tunnel microwave heating system [5],a precision temperature controller by using embedded system [6],an automatic temperature control system by using Zilog's Real Time Kernel (RZK) can be used to control varies devices to maintain a temperature [7],a design of automatic temperature control system for the dyeing machine [8],designed an automatic temperature control (ATC) system to arise the stability of laser diode (LD) [9],the design and implementation of digital temperature measurement and automatic control system [10].There is also a case study of automatic temperature control system on diagnosable discrete event system design [11].

This paper proposes a new invention of Smart TudungSaji for various applications. It has an automatic operation using the Arduino microcontroller. It uses a unique design such as 2 light-emitting diode (LED) bulbs and 2 sensors. This is to improve the function to become more efficient and effective way to maintain the food temperature is always warm. This project provides a comfort for human's life, easy to use and practical especially for career women. It also really helps to maintain quality and freshness of the food. Finally, this project can save power energy where it only functions when the temperature around the food below 60 $^{o}$C.

## METHODOLOGY

This project presents the design, construction, development and control of an automatic temperature controller system that applies to the Smart TudungSaji. The idea is based on the problem that happen in human life nowadays by improving the traditional TudungSaji. The block diagram of the system is shown in Figure-1. The integrated system of Smart TudungSaji consists of a temperature sensor LM35 for input, the Atmega 328p microcontroller for data interpretation and 2 bulbs as the output. The LM35 sensor is for object detection. The microcontroller uses the information provided by the

sensor to control the bulbs, and therefore to cut off the power supply.

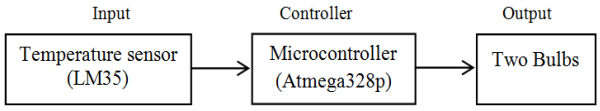


**Figure-1.** Block diagram of the smart TudungSaji system.

This project consists of two major parts, which are hardware and software design and development. In the hardware design, this project chassis is developed by using bamboo TudungSaji. It was chosen due to its nature as an insulator and better material compared to plastic. The bulbs will automatically switch on when environmental temperature in TudungSaji changes up to 60 $^{o}$C.This project is using microcontroller as a brain to control the bulbs according to temperature variation. The system measures the temperature of the LM35 sensor detection, where it will control the bulbs according to the setting in the programming.

In the software development, the algorithm is developed and simulated by using the Proteus 6.8 Lite software on a virtual circuit before it is downloaded and implemented on the Arduino. The system indicates the temperature from the Atmega 328p. Then, the temperature is compared with the setting value. If the environment in TudungSaji goes lower than 60 $^{o}$C, then the bulbs that connected to pin 2 will light up. As the temperature goes beyond than 60$^{o}$C, the bulbs have automatically turned off.

Figure-2 shows the voltage regulator circuit diagram. The voltage range of power supply is between 7V-15V. The larger heat will produce on the LM7805 voltage regulator if the input voltage is high. Therefore, the ideal voltage is 9V. The LM7805 will control the certain voltage to 5V in order to supply the Atmega328p microcontroller. If the polarity of the power source connection is incorrect, the diode is used for circuit protection. While capacitor is used to steady the voltage for both input and output of the LM3805. Red LED is used as power indicators.

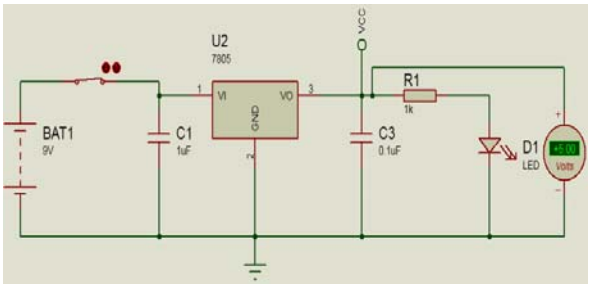


**Figure-2.**The voltage regulator circuit.

## RESULTS AND DISCUSSION

The results of this project are divided into two parts, which are software simulation and actual hardware. In software simulation, the automatic temperature control system for Smart TudungSaji can function according to the algorithm. Figure-3 and Figure-4 show the complete design of Smart TudungSaji circuit in Proteus simulation. After the 9V direct current (DC) battery supply is turned ON, the circuit starts to operate. It is connected to the voltage regulator circuit to produce 5V voltage. Then, the sensor starts its function to measure the changes of temperature surrounds the area in the TudungSaji. The Atmega 328p is the main component of the circuit. All the operations are controlled by this component to produce the output.

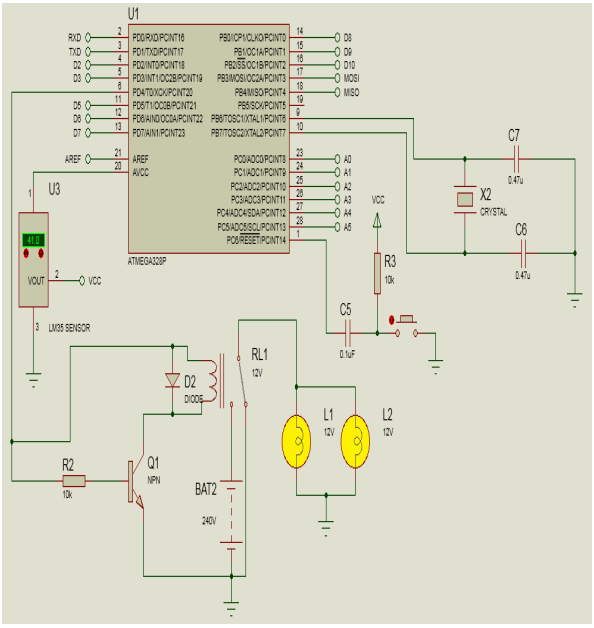


**Figure-3.** Bulbs turn on if LM35 detect temperature < 60 $^{o}$C.

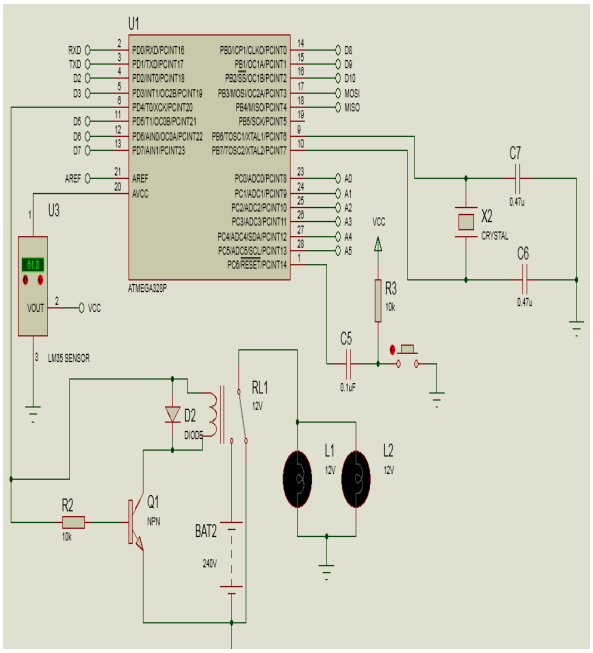

**Figure-4.** Bulbs turn off if LM35 detect temperature > 60 ºC.

The hardware results are shown in Figure-5 and Figure-6.Temperature sensor will detect the temperature from the surroundings while Atmega 328p will measure the temperature. The NPN power transistors are connected to Atmega 328p to control the bulbs whether to ON or OFF. The function of the NPN transistor is to boost up the relay in order for it to be able to open or close the switch. The bulbs will be OFF if the temperature sensor LM35 senses the temperature which is higher than 60 ºC. After all, the bulbs will be ON if the temperature detects lower than 60 ºC. If the temperature sensor LM35 detects the temperature is higher than 60 ºC, the bulbs will be off. If the temperature sensor LM35 detects the temperature is lower than 60 ºC, the bulbs will be on. Table-1 shows the result of the operation of the automatic temperature control after execution of the program. Based on the Table-1, case 1 indicates that the limit switch sensor do not detect the any surface. The bulb will turn on when the temperature sensor LM35 detect the actual set of temperature.

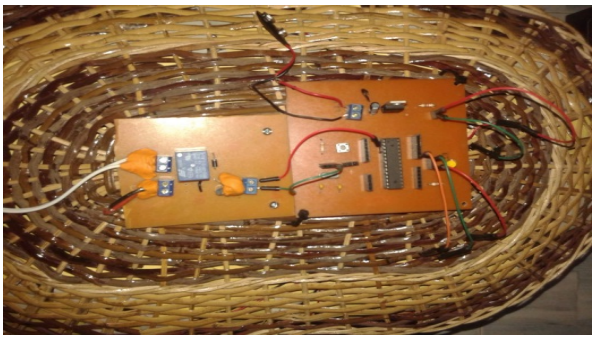

**Figure-5.**Circuit simulation of printed circuit board (PCB).

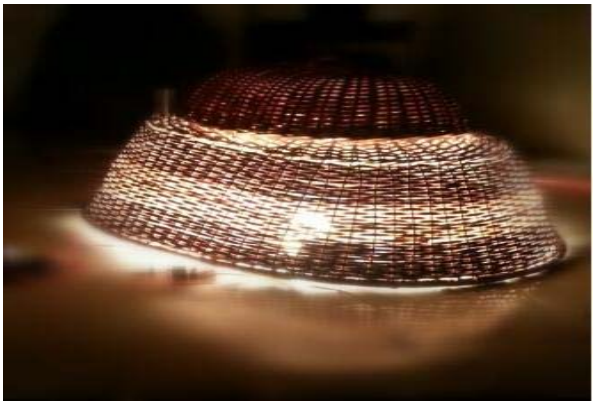

**Figure-6.**Actual hardware of Smart TudungSaji if bulbs turn on.

**Table-1.** Results operations of Smart TudungSaji.

| Case | Result |
|---|---|
| Limit switch detect the surface | bulb on |
| LM35 sensor detect temperature < 60ºC | bulb on |
| LM35 sensor detect temperature > 60ºC | bulb off |

## CONCLUSIONS

In brief, the development of this innovative Smart TudungSaji is successfully done. The hardware implementation together with its operation work accordingly as stated in the procedure. Few things are taken into account to make the circuit simple but efficient with high consistency. This project has fulfilled the main objective, which prevent the food from the bacteria and maintain the temperature of the food by using the temperature sensor LM35 which is controlled with Arduino. It also has a special feature by using a temperature sensor LM35 to cut off the power if the temperature higher than 60ºC. So, it can save the electricity. This project is really practical to be applied, especially to working woman to make their life simpler.

In the future, there are several improvements can be made in order to upgrade the features of this project such as using fiber to replace aluminium foil. It will be more producing of heat energy from the source of bulbs. Besides, this project can be improvised by replacing bulbs with thermistor coil where it can produce more heat energy.

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