Original Article

Designing And Implementation Of Embedded Based Alert System For Overheat Detection In Machines

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Abstract

Overheating of equipment has become a major issue in big enterprises, particularly in the petrochemical fields, throughout the years. When electrical, pneumatic, hydraulic, or electromechanical machinery, such as that used in production or treatment processes, malfunctions or begins to break down, at minimum a part of the machine's working temperature rises. This might result in a devastating breakdown at any moment. He expresses particular concern about the devices' temperature being monitored and maintained. A temperature-based, energetic material-containing actuator is chosen for action at a pre-registered temperature signaling the device's impending failure and placed in heat exchange with it. Whenever the machine achieves the pre-set temperature, the actuator indicates this by displaying a flag or providing some passively warning signal. The temperature transducer LM35 delivers the sensed data to the ATMEGA328 microcontroller, which processes it and transmits the temperature on the Liquid Crystal Display panel regularly. The LCD has a seven-segment display screen that can show up to three digits. By using four push buttons to control the maximum and minimum temperatures, the method helps to set and adjust the temperature limit. By pushing the set button, the user can increase or decrease the machine's temperature. Based on the temperature range the alert system varies. The exceeded temperature is divided into three ranges. If the temperature is in range 1 the LED glows. Then if the temperature reaches the second level, two LED glows and the buzzer also rings. If the temperature exceeds the setpoint and reaches the third level then the two LED glows, the buzzer rings and the SMS alert will be sent to the concerned mobile number via the GSM module.

Keywords— LM35, Global System for Mobile, SMS Alert, Overheat, Liquid Crystal Display

I. INTRODUCTION

Older industrial equipment was devoid of electrical equipment, and no periodic information could be obtained. All industrial equipment, however, is electronic and mechanical, with distinct alarms incorporated in computer controllers, even if they malfunction occasionally. To supply the finished product with data, instruments and equipment states are employed (e.g., shut-down when thermal fortification is stimulated). When appropriate, a security system can be managed geographically within the facilities or remotely from another place. Unlike a manually operated device, an exterior alert has the advantage of immediate location-related surveillance, allowing the property owner to take immediate action after receiving an alert signal. With the progress of technology and the increased use of machinery, preventing overheating has become one of the most pressing problems. Fires caused by overheated machinery may be fatal and damaging to industry and unit safety, as well as a danger to humans. The greatest approach to reduce these deaths is to react as rapidly as feasible to the unexpected crisis. As a result, standalone autonomous heating detection systems are required. Rapid detection, caution notice, and, in particular, the execution of any protective endpoint are all included in these gadgets. Temperature sensors in devices will detect undesirable abnormalities and, with the help of the processing device, will instantly indicate for precautionary measures to be performed. Warning and quicker notification will result in few material and life losses within those catastrophic scenarios. By evaluating

sensor information to the criterion specified in the controller software, alerts are also initiated. Radiation prevention, for example, activates an alert in the center of batch manufacturing, which has a profound impact on the performance of that batch. As a result of the temperature regulation, the manufacturing system's parameters (such as the production rate) may be modified to avoid this situation from occurring. To prevent a heat spread, it may be appropriate to forecast one and alter productivity levels accordingly [1,2].

Equipped with software and hardware, the built-in component or integrated circuit performs a certain function. As a hard drive, the microchip is the most essential element of the constructed hardware devices. Storage, Processing, Input-Output Module, and Analog-to-Digital Conversion Components make up the microcontroller. As an environment parameter is sensed, analog data is collected, and the microcontroller converts the analogous signals into a digitalized format. The gadget is known as the Precise heating controller, and this is a control mechanism that removes the fan's human temperature preset and raises the fan's velocity when the temperature rises and vice - versa. It has become necessary to use hardware or programming to determine the machine's heat as a result of high heat affecting various machinery in manufacturing industries in recent years. The objective of this study is to create and deploy an interconnected system for monitoring and warning workers in the surroundings to prevent disastrous damage. This gadget also checks the temperature level of equipment under a certain limit, and if the temperature level rises over that, the equipment will alert the user and turn on the cooling system. The suggested solution not only warns those near the machinery but also informs the respective person about the machine's condition via alarm messages sent over the system's GSM connection [3].

Throughout recorded history, the flame was both a place of happiness and a cause of sorrow for humans. 'Fire' is a personality combustion process that produces light and heat in varying degrees. Based on the source of the explosion, all fire incidents may be categorized into two categories: nature and human-made fire. Industrial fires, whether caused by man-made sources, would have been the principal cause of fire [4]. Construct the solution from a weblog titled "heat detector" about machine overheating. The article discusses the necessity for this construction and what will alleviate the present enterprise. Numerous people are required to keep tabs on laptop lots in a conventional manner to establish how many spaces are available to maintain a working device's capability at its optimal level. An automated predictor can be added to this machine to reduce labor costs. In the article, this circumstance is examined. Every part's purpose is also discussed. Heat identification is the heart of the research. To operate the circuit, a program must be written on it. Each switching relates to a position and the program counts the number of switching pushes to determine the number of available slots. Another example of an anode displayed on the program is studied extensively. For example, LEDs are utilized to display the number of available spaces. Additionally, the paper mentions the usage of a detecting system [5]. A customized overheat detection system has been developed to keep track of engine and APU bleed air leakage [6]. This system has been modified to meet the special requirements of regional aircraft. This study investigated how to make the fault isolation process easier and the aircraft dispatch process faster by employing an appropriate approach to map the defective sensing element of the overheat detection system's defective sensing element. This study made use of a fault diagnostics approach that is currently under development for the goal of pinpointing the specific location of a broken component.

In this study, a forest fire detection technique based on spatial forestry data is utilized. To determine fires, this approach relies on geographical data extraction and artificial neural networks. Using geographical data with flames present, a fuzzy rule foundation is constructed for the detection of fires. Fire zones are defined by translating digital pictures into color space and segmenting them [7]. The GPS was created for military purposes by the Department of Defense in the 1970s and is now supported by the US administration. Anybody having a GPS module has unlimited access to that too [8]. It is a 24hr global service that delivers exact velocities and accounting service and also exact three-dimensional data about the region. It is available to an uncountable range of diverse military, civilians, and commercial customers [9]. GSM modem is a full Quadband GSM offering in the form of an SMT module that can be integrated into customer applications. In a compact form size, it provides GSM functionality for data, voice, SMS, and fax. As a result of its small size, it can fit into nearly any space need [10]. An entity's location can be determined either using frequencies it broadcasts to broadband connections or the frequencies it receives from them in mobile networks based on GSM networks [11]. Alternatively, a cell device with an appropriate mobile app [12] may collect wireless data via the processor's wireless emitter and show it continually on a smartphone. A hybrid application was created to fulfill this aim. USB connectivity will continue to collect and show real-time temperature readings if the wireless system is interrupted. As a result of this multiplicity, the program's dependability is increased.

Fires caused by overheated machinery may be fatal and damaging to industrial and unit safety, as well as a threat to human life. The greatest approach to reduce these fatalities is to react as rapidly as feasible to the emergency circumstance. As a result, separate automated superheating surveillance systems are required. Automatic recognition, caution notice, and, in particular,

the execution of any protective endpoint is all included in these instruments. Temperature measurement sensors in devices will detect undesirable abnormalities and, with the help of the processing system, will instantly indicate for precautionary measures to be performed. Advance detection and the quicker warning may result in fewer losses and lives damage in these catastrophic scenarios.

The aims of this project are,

1. To monitor the temperature of equipment, particularly in hot environments such as manufacturing or processing units.
2. To use the LM35 to keep a record of equipment temperature and to warn the public via alarms and optical signs via LED indicators.
3. When the equipment overheats, send an alarm notification to the authorized people using the GSM network.

Sector 2 focuses on the hardware and software components necessary to construct the overheat detection system. Flowcharts and pseudocode are provided in sector 3. As input, several conditions are used to assess the operation of the predicted technique in sector four. The last chapter, chapter 5, discusses the advantages of utilizing the suggested system, which is summarized in the following section. Analyze the constraint and its remedies in further detail.

II. Hardware And Software Components

The hardware and software used to implement the overheat detection system are detailed below.

A. Hardware

A GSM alerting method is provided in the device, interface along with the LM35 sensor. The LM35 is used to detect the heat present in the machines. A GSM modem is utilized to produce Messages to the user's device, and a microcontroller and an LCD is being used for projection. The LED is used as a visual indication to specify the temperature range. Then for extra representation, the buzzer is employed as a hearing indication.

LM35: For finding the temperature of the machines the LM35 is used. The LM35 may be utilized in two different circuits. Both provide distinct outcomes. Only positive temperatures between 2 and 150 degrees Celsius may be measured in the first setup. It just energizes the LM35 and links the output straight to analog to digitized translators during this first setup. In the latter setup, we may make full use of the sensor abilities and detect the whole temperature region from -55 to 150 degrees Celsius.

LCD: LCD modules are the most frequently used devices for displaying the data. When an electrical current is supplied to a liquid crystal structure, the particle seems to evaporate, which is how LCDs work. This results in a variation in the degree of light passing through the polarized glass molecules as well as the degree of an upper polarizing filter. As a result, only a small quantity of light may get through the polarized glasses into a particular location of the LCD. As a result, the particular region might become dark in comparison to others.

LED: A light-emitting diode (LED) is a two-lead semiconductor light source that is used to alert the user to the presence of an overheat in the machines. When activated, it is a p–n diode that emits light. When a suitable voltage is supplied to the terminals, electrons can merge with electron holes within the device, releasing energy in the form of photons.

Buzzer: A buzzer is used as a notifying that the device is overheated. A little yet productive segment to add sound highlights to our undertaking/framework. It is a little conservative 2-pin structure henceforth can be effective in minimum space. This bell can be utilized by just controlling it utilizing a DC power flexibly going from 4V to 9V.

GSM: GSM is a global standard for smartphones. It represents for Mobile Communications Global System and is an acronym. Because it is a second-generation broadband network, it is also referred to as 2G. You'll need a mobile operator subscription (prepaid or contract), a GSM-compliant system (such as a GSM shield or a cell phone), and a SIM card to access the network (Subscriber Identification Module). A SIM, which holds information such as a telephone number, is issued by the network operator and can hold small quantities of contacts and SMS messages. To utilize GPRS for internet connection and for Arduino to seek the serve web pages, the network operator must supply an Access Point Name (APN) and a user id and password. For additional information on how to use the shield's data capabilities, see Connecting to the Internet.

B. Software

In Proteus, the proposed system simulation operates by adding to the microcontroller component either a hex file or a debug file on the schematic. It is then co-simulated, along with any analog and digital electronics components connected. This enables its application in a large spectrum of project prototyping in fields such as temperature monitor, SMS alert, and temperature indication.

III. METHODOLOGY

The proposed system consists of an LM35 sensor for temperature measurement. It is used to measure the heat generation in the machine. Based on the heat generation level the different alarm signals are generated. If the heat generated level is in range 1 then the LED is used to notify. If the heat level is in the range in 2then the buzzer is used. In case the heat level is in range 3 then the GSM module is used to send SMS. The LCD is placed in the system to notify the temperature level in numeric. For controlling the whole system, the Arduino micro-controller is chosen. The setpoint of the temperature can be increased or decreased by using the push button. The block diagram of the proposed system is given in figure 1

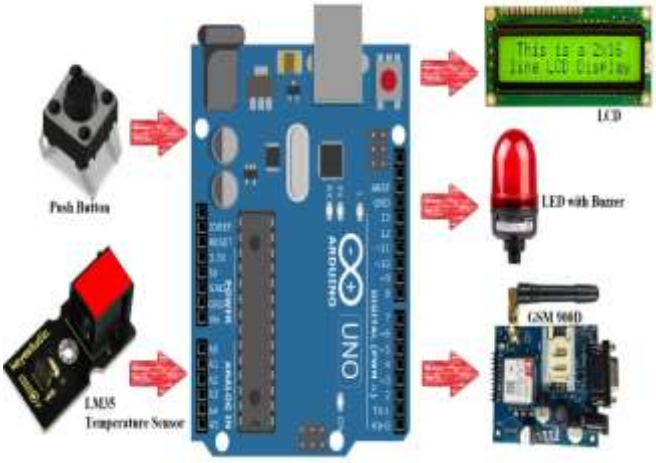

Fig. 1. Block Diagram of the Proposed System

Overheat monitoring system with controller alert employs automatic features to forecast the existence of an overheat occurrence that might end in fires and explosions in the machine. By using LM35 heat-sensing modules, the authorized user or proprietor will get a signal from a detecting component that detects overheating. GSM is used in these overheat alert systems to transfer the information from the sensors to the control center. However, the LM35 used in this device converts heat straight into the electrical parameter. As a result, the safety and notification screen triggers blinker or sounders, sprays (or triggers them simultaneously with the sensor), or requests for assistance from the appropriate authorities. Figure 2 represents the implementation of the proposed system in pseudo-code format.

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START
Sense Temperature
If (Temperature >= ***35*** °)
Activate **GSM**
Send **Message** to registered user
Show "**WARNING MESSAGE!**" on LCD
Visual indication – **LED**
Audio indication **- Buzzer**
Else
Go to temperature sense

Fig. 2. Pseudocode of the Proposed System

Figure 3 represents the workflow of the proposed system. At first, the LM35 is used to collect the temperature data of the machines. If the temperature is higher than the threshold values the GSM technology is used to send the message to the registered mobile number. Then LED and Buzzer is used to indicate the machines overheat.

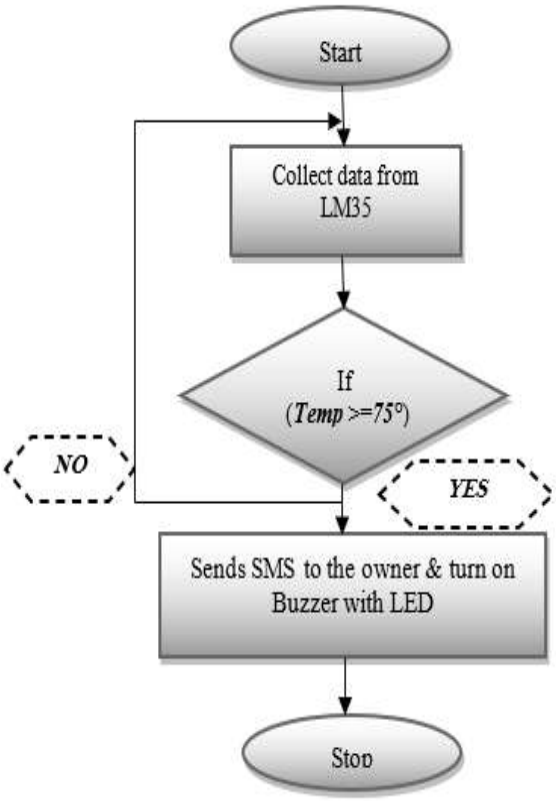

Fig. 3. Flowchart of the proposed system

A. Connections and Configuration

In the Proteus software simulation tool, the Arduino and all the required peripherals are taken and preloaded in the device column. Then the connections are given in figure 4:

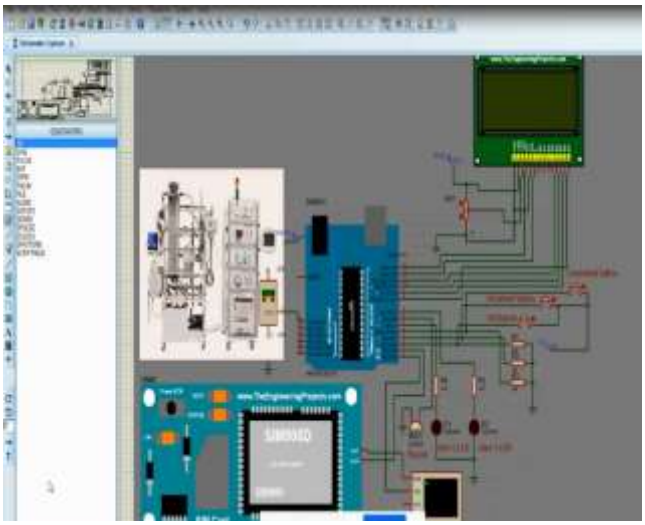

Fig. 4. Overall schematic diagram in Proteus

IV. Result And Discussion

The temperature is given as 29.79 degrees Celsius using the temperature sensor LM35. The setpoint of the temperature is given as 35 degrees Celsius using the push button. The actual temperature of the machine is set as lower than the set point. From figure 5 it is clear that the LCD is working properly and the setpoint is shown as 35 degrees Celsius and the actual temperature is shown as 29.79 degrees Celsius. Then the third line of LCDs is "Temperature OK". It seems that the temperature is detected and the message is also displayed properly. In this case, the temperature is maintained properly within the limit and it is acknowledged by the LED glows.

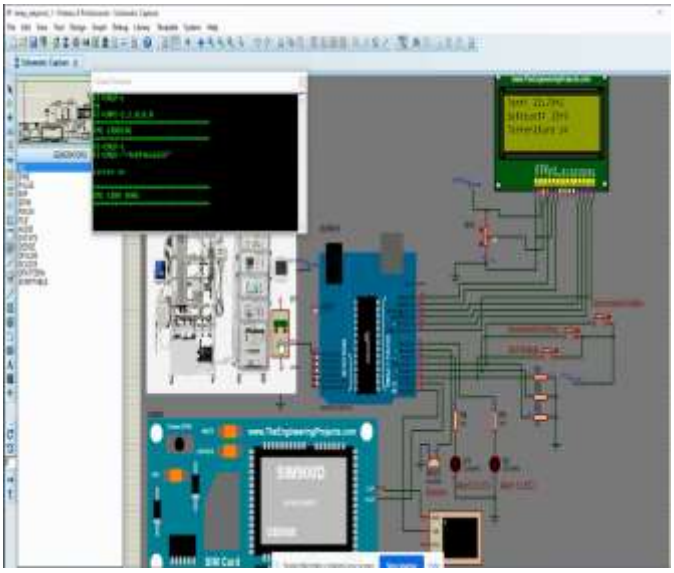

Fig. 5. Proteus simulation when the temperature of the machine is within the set point

The temperature is given as 40.04 degrees Celsius using the temperature sensor LM35. The setpoint of the temperature is given as 35 degrees Celsius using the push button. The actual temperature of the machine is set a little bit higher than the set point. From figure 6 it is clear that the LCD is working properly and the setpoint is shown as 35 degrees Celsius and the actual temperature is shown as 40.04 degrees Celsius. Then the third line of LCDs is "Level 1 Alert". It seems that the temperature is detected and the message is also displayed properly. In this case, the temperature is set a little bit higher than the limit and it is acknowledged by the two LED glows.

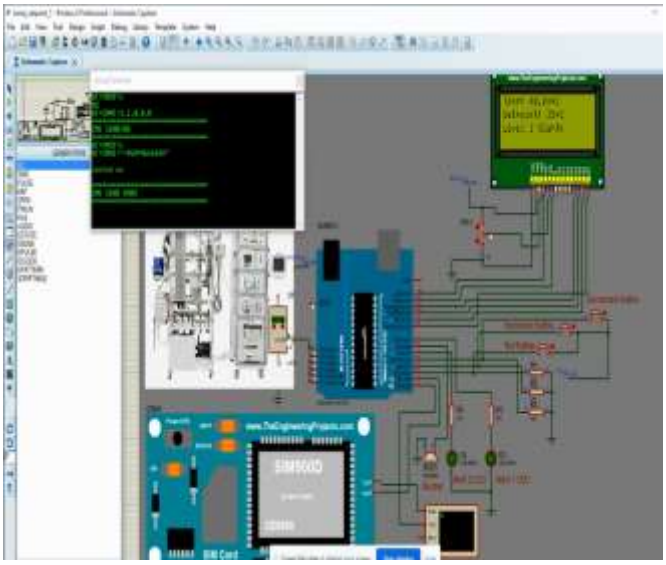

Fig. 6. Proteus simulation when the temperature of the machine exceeds the setpoint and reaches level 1

The temperature is given as 58.11 degrees Celsius using the temperature sensor LM35. The setpoint of the temperature is given as 55 degrees Celsius using the push button. The actual temperature of the machine is set as much higher than the set point. From figure 7 it is clear that the LCD is working properly and the setpoint is shown as 55 degrees Celsius and the actual

temperature is shown as 58.11 degrees Celsius. Then the third line of LCDs is "Level 3 Alert". It seems that the temperature is detected and the message is also displayed properly. In this case, the temperature is set as much higher than the limit and it is acknowledged by the two LED glows and ringing the buzzer. The temperature given to the sensor is very high and it is dangerous to the machine. So, by making the person alert the SMS is sent to the registered mobile number using the GSM module.

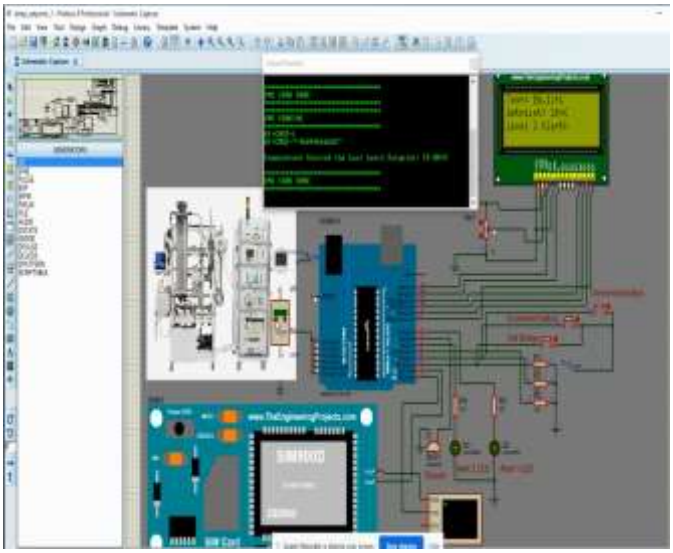

Fig. 7. Proteus simulation when the temperature of the machine exceeds the setpoint and reaches level 3

To check the working of the proposed system different set points are given to the system and check whether the sensor is working properly or not, then check the LCD working by displaying the set point, actual temperature, and alert message and finally the working of actuators like a buzzer, LED, GSM message is verified. The setpoint of the system is increased by using the push button which is connected to the digital pin 3. The arrow mark in figure 8 shows the push button which is used to increase the set point of the temperature. Then the LCD in the figure shows that the setpoint is increased to 39 degrees Celsius from 35 degrees Celsius.

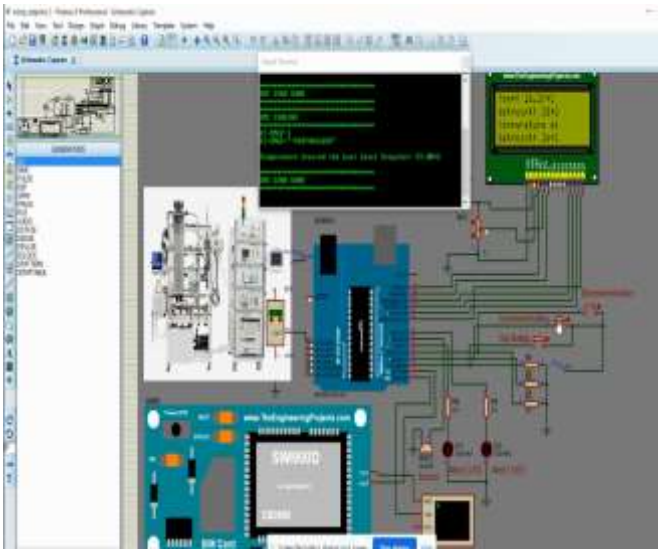

Fig. 8. Proteus simulation when increasing the set point of temperature

V. Conclusion

Overheating has been a problem for industry workers in history. Unfortunately, unplanned changes and crises continue to occur in the company without adequate warning. In all of these cases, overheating of the machines has been a common cause. Compared to other contemporary alarm systems on the market, this gadget is a bargain. It's also straightforward to install on any machine. Due to its adaptability and simplicity of operation, this technology may be utilized in a variety of applications. The suggested gadget may be effectively realized with the installation of a pretty advanced microprocessor and a very well

heat sensor like LM35 sensor. GSM alerts consumers when the heat surpasses the threshold (75 °C). User awareness of risky conditions and privacy violations may be increased by preventing them as quickly as possible. The proposed methodology has very limited cons and constraints. This system will check the temperature and send an alert message in various ways based on the temperature level. But if the end-user did not notice any alerts means the machine will get damaged due to heavy temperature. It leads to a decrease in the life span of the machines. In the future, the automatic control of temperature is implemented in the system. The LM35 sensor is used to measure the temperature of the machine. Then the setpoint is fixed based on the requirements. In the proposed system the alert signal is sent to the user based on the temperature level. The alert signal can be anything like LED, the buzzer sound, and a message to the mobile phone. The temperature is controlled manually based on the sensor readings. The PID controller is planned to implement, for maintaining and control the temperature of the machines. This idea will help to increase the life span of the machines and avoid any accidents.

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