Monitoring of Workplace Safety Using IoT

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Abstract. Security is the most critical thing in today's working conditions for the workers who are working in process industries and manufacturing industries. In order to have a safe workplace, a suitable safety system is yet to be developed for Micro, Small, and Medium Enterprises-level companies. Therefore, a safety system is developed to monitor the temperature of the employee while entering the workplace and company gate. Even for the single parameter health check, the control system to get the data from the sensor to the database and the database needs to be checked for the limitation of range whether it is acceptable or not. Based on the data condition, the sound alarm system needs to be connected and at the same time, a Short message service needs to be sent to the higher authorities. This information is sent to top management in an email form for their record and the information. The database contains data for the long period to have a statistical analysis of health issues for the employees. This statistical data analysis can help to improve the safety standard at companies. Considering the low-cost estimation, this safety system can be used in any MSME-level company.

1. Introduction

In a company, the safe workplace should contain safety equipment in their right place if not, more accidents will occur (i.e.) a small fire will lead to big fire like that a small accident will lead to a big accident to prevent this accident, it is recommended to use camera monitor system it provides safety for the workers as well for the company. Now the current world is suffering from corona, the basic test is the temperature test. In case if the test is not taken then there is a possibility of virus spread. The data were analyzed by the researchers between 2003 - 2020. According to the study conducted by the international journals of modern trends in engineering and research, Background Segmentation isn’t accurate when the feature of background changes, therefore, the proposed method uses accumulator images to be convenient with time changes. In this case, an advanced counter sensor is used here to rectify the inaccuracy. In any situation, it is expected to get the output must have more accuracy. Therefore, the proposed prototype is tested in different conditions [1,2]. Here MLX sensor is used so it gives more accuracy and the solution is going to use in indoor industries. In a further study, they measure the liquid temperature by using an MLX-90614 sensor so that it consumes less power likewise in this problem MLX-90614 sensor is used to measure the body temperature and it gives more accuracy [3,4,5]. The main aim is to install temperature sensors in industries and by using this can reduce the risk of current virus spread in a company and so on. To check the water quality, a mechanism was developed that uses coagulation through the machine learning process [6,7,8]. The anticipated result is that by using an automated temperature sensor, manpower would be reduced since a group of people will no longer be required to sense temperature. Machine learning and deep learning.
are mainly used in developing industrial safety machines [9,10]. The sensor are used to collect the data-gathering units and actings a front end [11, 12]. The communication between IoT and higher officials is fast other than people to people communication. Along with the camera monitor system and temperature sensor, attached a counter sensor to generate the attendance. The deep learning-based face recognition system has many advantages which use emotion and identify faces [13, 14]. The representatives can be observed by raspberry pi, If the temperature is high alert message will be sent to the controller/corresponding person of that industry. The alert messages are sent through IoT platforms such as raspberry pi based industry safety research [15,16]. The expected outcome is, by using an automatic temperature sensor the manpower will reduce, there is no need for a group of people to sense temperature and the communication between IoT and higher officials is fast other than people to people communication. If the safety equipment is not there, then the camera analyses it, by using raspberry pi, it sends alert SMS and email to the corresponding officer.

2. Approach and Processing

2.1 To monitor a safer workplace Scope of the work
To monitor a safer workplace in a company to take safety precautions from fire accidents using the camera monitoring system, prevent from Covid 19 in a company by a temperature sensor, and to maintain attendance sheet by the counter sensor.

2.2 Methodology
To complete the solution in a right and systematic way, the methodology was derived and shown in Figure1.

By Using a camera it monitors the fire extinguisher and fire buckets if the equipment is not thereby using raspberry pi, it analyses, and by using SMTP(simple mail protocol ) it sends mail. In a company, there is no automatic body temperature sensor in an entryway so there is a possibility of spreading the virus in industries by using this automatic body temperature can analyze the temperature of the worker and the signal is sent to the raspberry pi then the raspberry pi check whether the signal is low or high, if it is high it sends SMS to the corresponding officer by using smtp at the same time alarm started to ring. The counter sensor is used to count the number of workers entering and exits and to maintain the attendance log sheet without any error and the 5 v power supply is given to the raspberry pi. If the temperature is high and if the equipment is not there it sends SMS to the higher officers and alarms by using a buzzer. Then the SMS will be sent to the corresponding person if the person is in or off the company. Overall solution outcomes are to provide safety for the workers in the company.
2.3 Hardware Required

- Temperature sensor
- Counter sensor
- Camera
- Raspberry pi
- Alarm

2.4 Image Processing

The computer is first moved over the printed paper, where the built-in camera takes images of the text. Because of the high-resolution camera, the image captured will be of high quality, allowing for quick and accurate recognition.

2.5 Processing in advances

Skew Correction, Linearization, and Noise Reduction are the three phases in the pre-processing stage. The picture that was captured is messy. The noise-free image is then shifted to the segmentation step after pre-processing. It's a method of decomposing an illustration of a series of characters into individual symbol sub-images (characters). Interline spaces are verified in the binarized image. The picture is segmented into collections of paragraphs along with interline spaces if they are encountered. Lines from the paragraph.

3. Requirements for Hardware

3.1 Energy supply

A power supply is used to convert 240 volts AC mains electricity to something more usable, such as 12 volts DC. Linear and switch-mode power supplies are the two types of power supplies. A transformer lowers the voltage in a linear power supply. The voltage reduction ratio is calculated by dividing the number a 20:1. A transfer mode can supply easily lowers the voltage by switching the mains electricity on and off. In this case, the voltage reduction is important is determined by the ratio of on to off time. Switching happens at a breakneck speed of 1 second. A linear supply's bulky transformer can be replaced with a smaller one using this technique.

To generate a high DC voltage, the AC signal is rectified and controlled. A FET then quickly switches this on and off. The switched signal is then passed through a transformer, which, when The output is isolated from the mains by lowering the voltage. (in the interest of safety) The output-input is transferred to monitor the switching's required ratio, ensuring that output voltage remains stable. To rectify, filter, and RC the ac voltage to the desired amplitude If required, filter it with a capacitor and RC filter and then use an IC regulator to regulate the dc voltage, a transformer connected to the ac supply can be used. The regulators can be set to work with load currents ranging from tens of Power ratings ranging from milliamperes to hundreds of milliamperes, from mill watts to tens of watts.

3.2 Transformers

Transformers are a series of robots that transform. It is already stated that there are two types of transformers: those used in linear power supplies at low frequencies (50Hz) and those used in switch-mode power supplies at high speeds (>10KHz). Steel cores are commonly used in linear power supply transformers. The core is made of insulated steel. In a solid steel core, eddy currents will occur, reducing efficiency.

3.3 Regulated supplies

Supplies that are regulated Depending on how precise the supply must be, this solution might be sufficient. The live performance This configuration would have some ripple; the voltage will differ by a small amount, maybe a few percent, from the appropriate voltage. In a regulated supply, an IC is used to track the output voltage, equate it for the desired voltage, and change the output. The ripple effect of regulators is much smaller and is commonly used to protect against over-current and
overheating, which allows them to automatically shut down and render the supply indestructible. A 7805, a typical 5-volt regulator, is shown on the right.

3.4 Raspberry Pi

The Raspberry Pi, or Raspberry pi as it's known by friends, is a tiny machine. It has everything might like, including a 700MHz ARM processor, RAM, USB, Ethernet, and, most importantly, a comb (see Fig.2) welded to the electronics board and attached directly to the processor. This comb enables us to use digital inputs and outputs (that are freely configurable) that are directly managed by the operating system. Raspberry Pi is available as an A and B model. The hardware is what sets it apart from its smaller sister, the model. There is an Ethernet port on B, two USB ports instead of one, and more RAM (512MB against 256Mb of model A). The costs are different: the letter B model is currently € 37, while the A model is just € 28. Model A is smaller and lighter, making it ideal for embedded (dedicated) applications where space is at a premium and the Model B's extra features aren't needed. Model B, on the other hand, is much more flexible than model A, since it can be linked to a computer network and accommodate more applications and processes. Both Linux distributions are compatible with the device's operating system. Linux was chosen in part because of its low memory overhead, which enabled a fully functional OS to be run on such a basic computer with no permanent storage built-in. Linux is also usually free, and many distributions have a lot of potential as a CS learning tool. already have several programming languages installed.

Figure 2 Raspberry pi (Gareth Halfacree)

3.5 Components – Raspberry Pi

ARM-based CPU/GPU - The Broadcom BCM2835 System has a Chip of(SoC) has an ARM processor and the Video core four graphics processor. The computation is done using CPU run (inputting data, performing calculations, and producing output), while a GPU handles the graphics output. Broadcom BCM2835 System the Chip (SoC) has an ARM processor and Video core four graphics processor (GPU). CPU is responsible for all of the computations to make the machine works (inputting data, conducting calculation, and generating output), while a GPU is responsible for graphics of output. LEDs (non-emitting diodes) are perfect for the process. USB (Universal Serial Bus) – It is universal networking of all secondary computers. Using this port or add a mouse to the keyboard if it has one to maximize the number of ports. HDMI -An HDMI cable may attach the high-definition tv or another compatible device to this connector. Battery - the 5v Micro USB of the power connector that can be inserted into any suitable energy supply. SD slot - They are available for purchase from the vendors, but if it has a Linux computer and the required tools, it can also download an operating system and save it to the hard drive. Ethernet -Only Model B has this connector, which allows for wired network connectivity.

3.6 Technology – Raspberry Pi

It is available for use in both versions: The A model uses minimum energy and an Ethernet port is not provided. The B model frame, on the other hand, is made in China and comes with an Ethernet port. A
variety of open-source software is included with the Raspberry Pi. Networking and digital online technologies are two examples. In 2014, the Raspberry Pi Foundation released the platform module, which encapsulates a B model in embedded systems.

3.7 Each MEMORY
This has got similar to a computer to computer the minimum functionalities. There are also different interfaces for other remote applications. It also needs mass storage, which is provided by an SD flash memory card. As a result, the Raspberry Pi board will boot from this SD card in the same way that it did previously how a pc does.

3.8 CPU
The Central Processing Unit, which is in charge of carrying out the computer's orders by logical and mathematical operations. It is powered by an ARM11 processor, which is also used in Samsung's Galaxy phones.

3.9 Graphics Processing Unit
This is a customized processor in the latest small system for the model that the programmed to accelerate data processing.

3.10 Display
HDMI and Composite are the two connectivity solutions available on the Raspberry Pi board. Multiple displays to be paired. HDMI 1.3 and 1.4 are also supported, but It is suggested to use a 1.4 cable. The Raspberry Pi's O/Ps support HMDI.

3.11 The PiCamera v2
The PiCamera v2 is a new version of this accessory that was released in April 2016 to replace the now outdated PiCamera v1.3. It is backward compatible with all previous Raspberry Pi versions. In reality, the flat cable hasn't changed and can still be plugged into the dedicated connector on the upper side of all Raspberry Pi boards. This latest module includes an 8-megapixel (fig. 3 shows) Sony IMX219 sensor, which replaces the previous model's 5-megapixel Omni Vision OC5647. The Raspberry Pi camera module is a handy add-on that helps to do a variety of useful and innovative things with the little computer. To get the most out of the camera's features, it will be needed at least a rudimentary understanding of Bash or Python scripting. Regardless, the RPI Camera GUI is accessible via SSH. The Pi Cam Web Interface (RPCWI) software, which can be found at this site, is a much better tool for the job.

![Figure 3 Pi camera (Arducam)](image)

This web application, as the name implies, offers a user-friendly GUI that helps to control almost all camera settings using a normal browser. RPCWI also has a host of features that make it a great platform for dealing with the camera module. This includes functions like previewing, managing, and downloading stored photos and videos, as well as time-lapse and planned photography and filming, as well as motion-triggered recording image capture, and more.
4. Connecting the display Monitor

With a composite video (AV) or HDMI cable, connect the TV screen or projector to the Raspberry Pi display. The TV screen/monitor will not turn on the first time, even though it is tuned to the correct AV channel. After unplugging the Raspberry Pi board's power supply cable once (while leaving the monitor's power supply on), plug it back in. If the SD card is not disabled, the display can now come on. Figure 4 shows raspberry pins.

![Select connection to convert to HDMI](image)

**Figure 4** Raspberry pi pins

4.1 What do these converters do

To put it another way, each of these converters allows two devices to communicate using two different signal types. Depending on the two signs were dealing with, things get a little more complicated. I'll go through each of the forms mentioned above and try to give a basic understanding of what they do.

4.2 USB to HDMI

A USB to HDMI adapter attaches to a device's USB port, effectively adding an HDMI output to the computer. This helps to attach device to a monitor that supports HDMI. This also enables to attach several additional displays to the screen, resulting in much more efficient monitor setups. The Mini deck 3.0 is an excellent device for sending high-definition video and audio from the screen to the HDTV.

4.3 Composite to HDMI

DVD players and video game consoles that are a little too old to have HDMI support are commonly used as composite sources. Composite, like VGA, is an analog signal that must be converted to a digital signal in its entirety. It can't just move from part to HDMI with a simple cable. Component to HDMI converters will enable to view these types of sources on the HDMI display.

4.4 Web cameras interfacing with Raspberry Pi

Due to its importance in performing image processing applications, the Raspberry Pi remains in its pride point. A Raspberry Pi can be used to create real-time image processing schemes because it has a webcam GUI, allowing us to process algorithms for identification, recognition, segmentation, surveillance, and so on.

4.5 Principles of Software Requirements

The Raspberry Pi has quickly grown in popularity among hobbyists, thanks to its low price and wide range of capabilities. This is particularly true when it had to sign up for waiting lists before this board's output was announced, and prepare to wait up to six months for aboard. Many operating systems are supported by the ARM processor (mostly Linux-based). As a result, everybody will work in his or her desired setting. No, Windows isn't compatible with ARM processors, and even if it was, would it do it on a computer like this? Consider how many blue screens there will be... they'd be closed all the time.

No, not even Mac OS X will run on ARM! Many developers competed to recompile the kernel of the most common operating system. common Raspi after the first Raspi was shipped around the world common Linux distributions designed specifically for the Raspberry Pi board's hardware, and it will have a large range of operating systems optimized for the Raspberry Pi board. The following are some of the most well-known operating systems that have been modified to work with Raspberry: Raspbian (a lighter version of Debian), Pidora (the popular Fedora's daughter), and Arch Linux ARM (review of Arch Linux).
Then there are native operating Android 4.0, Google Chrome OS, and UNIX distributions like FreeBSD, and others are examples of those programs. (A full list can be found here.) The Raspberry Pi is the subject of a website called Raspberry Pi. On the org website, it will find an official list of compatible operating systems. The official list of operating systems that are supported on the RaspberryPi.org website can be found here. It will look at how to install and configure Raspbian in this post. This distribution appealed to me because Debian (the mother of Raspbian) is well-known and well-documented. As a result, finding alternatives and assistance in the event of a problem during use is much easier. It can easily build interesting applications with this operating system, a broadcast center, a web portal, a mail server, a torrent server, databases, FTP... It will share all of this with as many mobile devices. It can only know to watch outputs and to read the inputs today, which is the first step. Python programming language and the few lines of the code are used by GPIO.

4.6 Python
Python is a high-level programming language that is interpreted, dynamic, object-oriented, and general. Between 1985 and 1990, it was modeled by Guido van Rossum. Python source code, like Perl, is free and open-source (GPL). This tutorial will give a good understanding of the Python programming language. Python is a complex, interpreted programming language with a high degree of abstraction. using an object-oriented programming language Python is a complex, interpreted programming language with a high degree of abstraction. for an object-oriented programming language. It also substitutes English keywords for punctuation and has fewer syntactical structures than other languages. Python is Translated The interpreter translates Python at runtime. It does not need to compile the program before running it. This is close to the way that PERL and PHP function. Python is interactive; it can connect with the interpreter by writing programs directly at a Python prompt. Python is a programming language that focuses on objects. Object-Oriented Programming is a form of programming that uses objects to solve problems. style or technique is supported by Python which encapsulates code within items.

To teach the camera to recognize the artifacts of Personal Protective Equipment, Python is used in combination with the Raspberry Pi processor (PPE).

4.7 SMPT
The TCP/IP protocol's configuration layer To send and receive email over networks, SMTP employs a "register and forward" process. A message is translated into a sequence of text strings separated by code words as it is sent (or numbers) that define the context of the segment. SMTP generates these instructions, which are deciphered by email server tools. On the way to its destination, each message passing through several computers as well as their respective MTAs. Before going on to the next unit on the lane, it is temporarily saved. Consider it like a letter passing through many hands-on its way to the right mailbox Simple Mail Transfer Protocol The acronym SMTP stands for Simple Mail Transfer Protocol. (Fig. 5 and 6 shows) The Simple Mail Transfer Protocol (SMTP) is a series of communication standards that enables software to transmit email over the internet. It's an application that sends messages to other device users with e-mail addresses.

![Figure.5 SMPT(Javatpoint)](image-url)
5. Summary

The complete safety system is developed to monitor the working people's health safety by introducing temperature sensors to get data at frequent intervals and compared with a standard allowable limit which is fed into the company server. In addition to that existing safety items such as fire buckets, fire safety cylinders, and other safety equipment were tested to assure that all are available for safety at the place. While employees are entering at the main gate and each working place, people counting were introduced and tested which helps to strength at each workplace. With this developed system, the control system is verified to get the data from the human and sent alert message to the officer and email to the management personnel. As an alert system, initially sound alarmed is provided at the workplace and if it does not rectify, then the message is sent to higher authorities. All the data are stored in local as well as a cloud which can help the company to analyze the cases to improve the safety system at the workplace. Overall this developed system can help MSME to improve their safety standard at a cheaper price.

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