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AUTONOMOUS TEMPERATURE AND MASK SCAN ENTRY SYSTEM

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Abstract: This project is entitled as" **AUTONOMOUS TEMPERATURE AN MASK SCAN ENTRY SYSTEM "**using IOT**.** The System presents a sophisticated solution leveraging cameras and sensors to ensure public health compliance. Through facial recognition, the system identifies individuals entering a premise and instantly detects mask presence. Should a person not be wearing a mask, the system activates a buzzer alert. Simultaneously, a temperature sensor integrated into the system measures body temperature. If an elevated temperature is recorded, indicating a potential fever, the buzzer is triggered, signalling the need for further assessment. This system aims to autonomously monitor and enforce mask-wearing policies while also providing an initial screening for elevated body temperatures. By combining these functionalities, it creates a comprehensive entry system vital for public spaces, enhancing safety measures in the ongoing battle against contagious diseases.

I. INTRODUCTION

1.1 PREAMBLE

The main aim of an automatic temperature and mask scan system is to proactively control the spread of infectious diseases by identifying individuals who may be at risk of transmitting illness. This is typically achieved through two key functions:

1. Temperature Scanning:

Non-invasive infrared sensors or thermal cameras are used to measure a person's forehead temperature without physical contact. Infrared temperature sensor for automatic system. Readings are compared to pre-set thresholds to identify individuals with potentially elevated body temperatures, a common symptom of many infectious diseases. Alerts are triggered if a high temperature is detected, typically through visual or audible signals, and may initiate further protocols like denying entry or prompting for secondary screening.

2. Mask Detection:

Facial recognition cameras or computer vision algorithms are used to analyze incoming video footage and detect whether a person is wearing a mask. Systems can differentiate between different types of masks (surgical, cloth, etc.) and even identify masks worn incorrectly (e.g., not covering the nose and mouth). Similar to temperature checks, alerts are triggered for non-compliance with mask mandates, potentially restricting entry or prompting reminders to wear a mask properly.

1.2 ELECTRONIC GADGETS:

1. Camera Module: Captures facial data for mask detection using facial recognition algorithms. Mask Detection Module: Analyzes the captured images to determine if a person is wearing a mask or not, triggering an alert if no mask is detected.
2. Temperature Sensing Module: Utilizes a temperature sensor to measure the body temperature of individuals, triggering an alert if the temperature is above a predefined threshold.
3. Buzzer: The buzzer acts as an audible warning signal, drawing immediate attention to the identified non-compliance with mask protocols or a potential health risk due to an elevated body temperature.

These components work in tandem - the camera captures facial data, the mask detection module processes this data to determine mask compliance, and the temperature sensing module concurrently measures body temperature. If any discrepancies are identified—such as lack of mask or elevated temperature—the alert system, represented by a buzzer, activates to signal the need for further assessment.

1.3 DIGITAL IMAGE PROCESSING:

A wireless electronic notice board is a device that can display messages or information sent from a remote source, such as a mobile phone or a web browser.

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It is an application of IoT (Internet of Things), which connects devices and objects to the internet and enables remote control and communication. Wireless electronic notice boards can be used in various places, such as schools, colleges, banks, and other public places, to display announcements, advertisements, alerts, or other information.

1.4 PROBLEM DESCRIPTION:

Automatic temperature and mask scan systems are valuable tools for access control and health screening, but they are not without their challenges. Here are some potential problems to consider:

- Accuracy: Sensors used for temperature measurement and mask detection can be inaccurate, particularly under certain conditions (e.g., extreme temperatures, low light, facial hair).
- Calibration: Sensors require regular calibration to maintain accuracy.
- System Failure: Hardware or software malfunctions can disrupt the system and lead to false positives or negatives.
- Data Security: Systems may collect sensitive data like temperature and facial images, raising privacy concerns if not secured properly.
- Integration: Integrating the system with existing access control or security systems can be challenging.

1.5 OBJECTIVE:

The objective of the project is to establish a seamless communication interface between a microcontroller and an MQTT (IoT platform), enabling real-time data transmission. Through this system, users can input information via a physical button connected to the microcontroller, which is then relayed to the microcontroller through MQTT. The received data is subsequently displayed on the I2C LCD display in real time. This project aims to facilitate remote and instant updates on the display, enhancing communication efficiency in various settings, such as public spaces, educational institutions, or office environments.

1.6 SCOPE:

The scope of an automatic temperature and mask scan system can vary depending on its intended purpose and implementation. Here are some key elements to consider:

Functionality:

- Temperature scanning: Contactless (infrared sensor, thermal camera) or contact-based (thermometer)Accuracy and sensitivity of the sensor. Customizable temperature thresholds for triggering alerts.
- Mask detection: Ability to identify various types of masks (surgical, cloth, N95). Handling obscured faces (glasses, hats, beards). Accuracy and sensitivity of the detection algorithm.

Output and Alerts:

- Visual indicators (LED lights, screens) for temperature and mask compliance.
- Audible alarms or notifications for non-compliance.
- Data logging and reporting capabilities.
- Integration with access control systems to restrict entry for non-compliant individuals.

By defining the specific scope and requirements of the automatic temperature and mask scan system, you can ensure it effectively meets your needs while addressing potential challenges.

II. SYSTEM SPECIFICATION

2.1 SOFTWARE REQUIREMENTS:

- Arduino ide
- Embedded C
- Python

2.2 HARDWARE REQUIREMENTS:

- Microcontroller
- Temperature sensor
- Buzzer

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III. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

In the existing systems for monitoring mask compliance and temperature predominantly rely on manual checks by personnel at entry points. These systems often lack real-time assessment capabilities and depend heavily on human observation. Some limited implementations utilize thermal scanners for temperature checks but do not integrate mask detection. Overall, the current systems lack an autonomous, integrated approach that combines facial recognition for mask adherence and temperature sensors for fever detection. The absence of an automated system leads to potential inconsistencies, delays, and increased dependence on manual oversight, highlighting the need for a comprehensive, technologically advanced solution.

DISADVANTAGES:

1. Inconsistency and Human Error
2. Time-Consuming Process
3. Limited Scalability
4. Health Risks for Personnel
5. Lack of Real-Time Monitoring

3.2 PROPOSED SYSTEM:

The proposed System integrates cutting-edge technologies to revolutionize health and safety protocols. By utilizing advanced facial recognition through cameras, it instantly identifies mask compliance upon entry. If a person is detected without a mask, an immediate alert is triggered via a buzzer. Additionally, the system incorporates a temperature sensor to swiftly and accurately assess body temperature. Upon detecting an elevated temperature indicative of a potential fever, the system activates the alert condition on the buzzer. This comprehensive, autonomous approach aims to proactively enforce mask-wearing regulations and swiftly identify individuals with potentially heightened health risks, ensuring a safer environment in public spaces.

ADVANTAGES:

1. Real-Time Monitoring
2. Autonomy and Efficiency
3. Early Detection of Health Risks
4. Scalability
5. Integration of Technologies

IV. PROJECT DESCRIPTION

4.1 BLOCK DIAGRAM

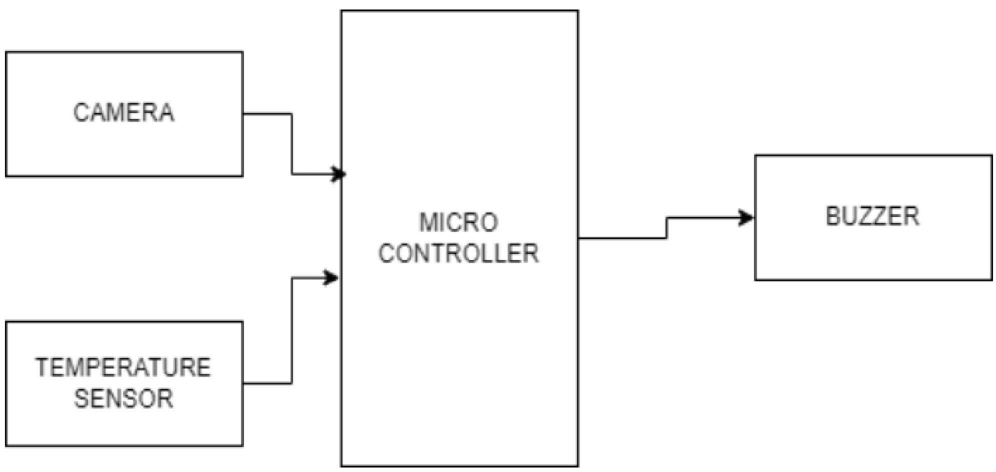

FIG 1. Block Diagram

4.2 BLOCK DIAGRAM EXPLANATION

The block diagram for the Wireless Electronic Notice Board System comprises three main components:

MQTT: This component serves as the communication bridge between the user interface and the microcontroller. It receives data inputs from various sources, primarily a button press in this setup. When a user interacts with the button, triggering an event, the data is sent to the MQTT Broker for processing.

Microcontroller: Acting as the core processing unit, the microcontroller subscribes to the MQTT Broker to receive incoming data. Upon receiving input from the MQTT Broker, it interprets the information, specifically the data sent from the button press event. The microcontroller processes this data and prepares it for display.

I2C LCD Display: This output component receives processed data from the microcontroller. The microcontroller sends the formatted information to the I2C LCD Display, which then showcases the received data in a human-readable format, such as messages, notices, or alerts. The flow within this system begins with the user interacting with the button, which triggers a signal. This signal is transmitted via MQTT to the broker. The microcontroller, subscribed to the broker, retrieves this input. It processes the received data and subsequently sends instructions to the I2C LCD Display, resulting in the display of the intended information.

4.2.1 NODE MCU

Node MCU is an open-source Lua based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware which is based on the ESP-12 module.

This protocol uses the SDIO mode of the ESP8266 to communicate with other processor's SPI hosts. The electrical interface is connected through signal line No.4, including the SCLK, MOSI, MISO and interrupt signal No.1 in the SPI protocol (note: no CS signal). Downloading the ESP8266 SDIO can be different from downloading other programs. When the ESP8266 starts, the system reads the pin shared by the SPI interface and the SDIO interface by default.

FIG 2. Node MCU

4.2.2 IR Temperature Sensor(MLX90614)

The MLX90614 is a **Contactless Infrared (IR) Digital Temperature Sensor** that can be used to measure the temperature of a particular object ranging from -70° C to 382.2°C. The sensor uses IR rays to measure the temperature of the object without any physical contact and communicates to the microcontroller using the I2C protocol.

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Specifications

- Operating Voltage: 3.6V to 5V (available in 3V and 5V version)
- Supply Current: 1.5mA
- Object Temperature Range: -70° C to 382.2°C
- Ambient Temperature Range: -40° C to 125°C
- Accuracy: 0.02°C
- Field of View: 80°
- Distance between object and sensor: 2cm-5cm

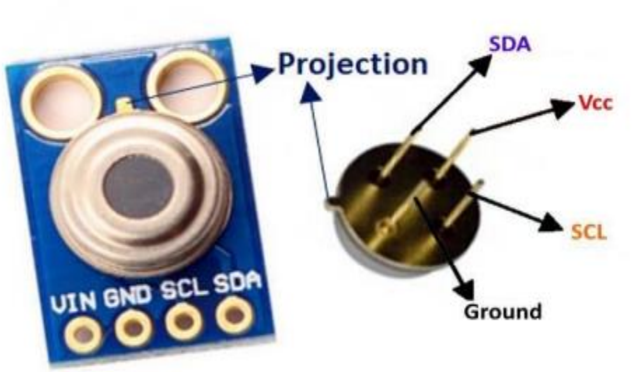

FIG 3. IR Temperature sensor

BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Application

- Alarming Circuits, where the user has to be alarmed about something
- Communication equipment
- Automobile electronics

Portable equipment's, due to its compact size

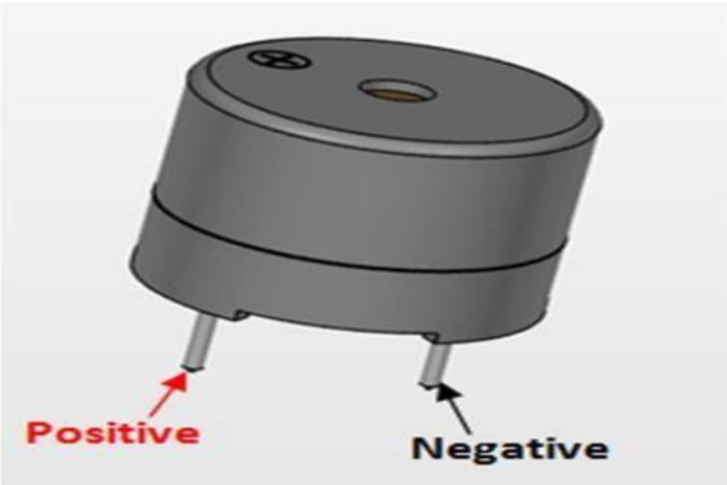

FIG 4. Buzzer

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V. IMPLEMENTATION

MODULES

- **PREPROCESSING**
- **HAAR CASCADE CLASSIFIER**
- **GLCM FEATURE EXTRACTION**

5.1 PREPROCESSING

Image pre-processing involves basic operations on intensity images to improve data quality by suppressing distortions or enhancing important features for further analysis. Conversely, image restoration focuses on recovering the original image from a corrupted or noisy version, which can result from factors like motion blur or misfocus. Unlike image enhancement, which aims to make images visually appealing without necessarily maintaining scientific accuracy, restoration aims for realistic data. While enhancement techniques like contrast stretching can remove noise at the cost of resolution, this may not suffice for certain applications, such as Fluorescence Microscopy. Here, more advanced methods like de-convolution are needed to recover object details due to inherent resolution challenges.

5.2 Haar cascade classifier

Haar – Cascades

Haar- like features are rectangular patterns in data. A cascade is a series of "Haar-like features" that are combined to form a classifier [14]. A Haar wavelet is a mathematical function that produces square wave output.

The Haar cascade classifier is a key technique in computer vision, particularly in face detection. It utilizes Haar-like features, which are rectangular patterns, to form a series of classifiers. These features are evaluated across the image by sliding a chosen scale window, and if the difference between the areas exceeds a threshold, it matches the feature. However, one feature alone may not suffice for accurate detection, hence the use of cascades of weak classifiers. Adaboost, a committee learning algorithm, combines these weak classifiers into a strong one. The integral image, or summed area table, facilitates fast computation of Haar features, minimizing processing time while maintaining high accuracy. This approach revolutionizes face detection, finding applications in various fields of computer vision.

5.3 GLCM FEATUES

The gray comatrix function is used to create a gray-level co-occurrence matrix (GLCM), which calculates the frequency of occurrence of a pixel with intensity value i in relation to a pixel with value j. By default, it considers the immediate right neighbor as the spatial relationship, but this can be customized. The GLCM's elements represent the sum of occurrences of pixel pairs with specific values. To manage processing complexity, the input image is scaled to reduce intensity values from 256 to eight levels, controlled by parameters like Num Levels and Gray Limits.

Multiple GLCMs can be generated by specifying an array of offsets to the function, defining various pixel relationships. This allows for analysis from different directions and distances, enabling more comprehensive image statistics. To create multiple GLCMs, specify an array of offsets to the gray comatrix function. These offsets define pixel relationships of varying direction and distance. For example, you can define an array of offsets that specify four directions (horizontal, vertical, and two diagonals) and four distances. In this case, the input image is represented by 16 GLCMs. When you calculate statistics from these GLCMs, you can take the average.

VI. RESULT ANALYSIS

Automatic temperature and mask scan systems have become increasingly important for various purposes, including pandemic control, security, and access control. Analyzing the results from these systems is crucial for understanding their effectiveness and making informed decisions. Here's a breakdown of key points for result analysis:

Data Types:

- Temperature Data: Analyze the distribution of temperature readings, identify outliers, and compare to normal body temperature ranges. Look for trends over time and across different locations/groups.
- Mask Detection Data: Analyze the accuracy of mask detection (true positives, false positives, negatives), identify factors affecting accuracy (lighting, mask type, facial features), and track compliance rates.

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Analysis Methods:
- Descriptive Statistics: Calculate mean, median, standard deviation for temperature and mask detection data. Use visualizations like histograms and scatter plots to understand data distribution and relationships between variables.
- Correlation Analysis: Identify potential correlations between temperature and mask wearing, temperature and time of day, mask type and accuracy, etc.
- Predictive Modeling: Train machine learning models to predict potential risks based on temperature and mask data.

VII. CONCLUSION

In conclusion, the System presents an innovative solution to address critical health and safety measures in public spaces. By seamlessly integrating facial recognition technology and temperature sensors, this system ensures swift and automated monitoring of mask compliance and body temperature. The ability to promptly detect mask non-compliance and elevated temperatures through the buzzer alerts enables immediate intervention, fostering a safer environment. This autonomous system significantly reduces reliance on manual oversight, enhancing efficiency and accuracy in enforcing health protocols. As an all-encompassing entry monitoring system, it stands as a pivotal tool in proactively mitigating health risks and upholding public safety, catering to the evolving needs of safeguarding against contagious diseases in today's world.

VIII. FUTURE ENHANCEMENT

Automatic temperature and mask scan systems have become increasingly common in recent years, particularly due to the COVID-19 pandemic. These systems offer a contactless and efficient way to screen individuals for potential health risks. However, there is always room for improvement, and several exciting future enhancements are on the horizon for these technologies.

1. Enhanced Accuracy and Reliability:

- Temperature Scanning:

Non-invasive methods: Moving beyond forehead temperature readings, which can be influenced by external factors, future systems may utilize under-the- tongue or ear canal thermometers for more accurate core body temperature measurements. Multi-sensor approach: Combining thermal cameras with traditional thermometers can provide a more comprehensive assessment, taking into account factors like fever and sweating.

- Mask Detection:

Advanced algorithms: Employing deep learning algorithms trained on vast datasets of facial images with and without masks can significantly improve mask detection accuracy, even in challenging conditions like low light or facial coverings. Mask type identification: Future systems may be able to distinguish between different types of masks (surgical, cloth, N95) and alert users if an inadequate mask is worn.

2. Integration with Other Health Monitoring Systems:

- Symptom detection: Systems could be equipped with additional sensors to detect coughing, sneezing, or labored breathing, providing a more holistic health screening.

- Biometric identification: Integrating with facial recognition or fingerprint scanners can streamline the screening process and personalize health data collection.

- Real-time data analysis: Continuous monitoring of vital signs and symptom indicators could enable real-time health risk assessment and prompt intervention if necessary.

3. Improved User Experience and Privacy:

- Touchless interfaces: Voice commands or gesture recognition can eliminate the need for physical contact with the system, enhancing hygiene and user comfort.

- Data anonymization and security: Robust data encryption and anonymization techniques can ensure user privacy while still providing valuable health insights.

- Personalized feedback and education: Systems could offer personalized health advice and educational resources based on individual readings, promoting preventative healthcare practices

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IX. SCREEN SHOTS

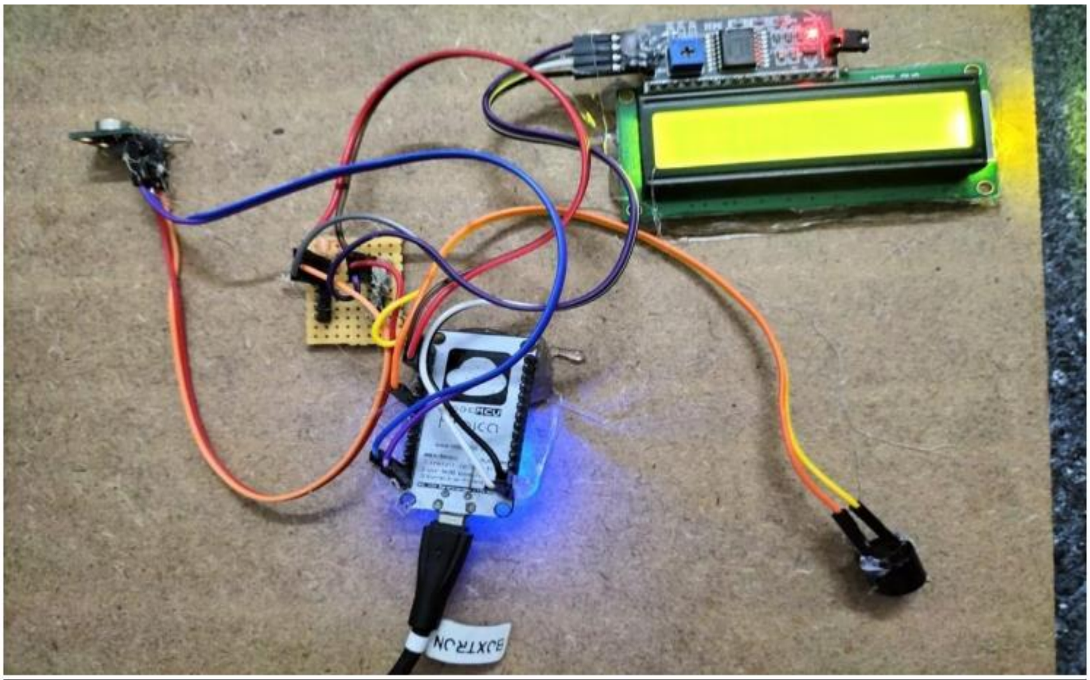

FIG 6. IMAGE

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