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Intelligent Home Security System Using Arduino & IOT Sensors

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Abstract - A smart home security system is one that combines cutting-edge technology to safeguard your family and property. It is intended to spot any possible risks, such as robbers, fires, and gas leaks, and to notify you of them. These systems keep an eye on your house and notify you of any strange behavior using a combination of sensors, cameras, and other gadgets. This intelligent home security systems can even be managed remotely through a smartphone app, enabling you to keep an eye on your house from any location. Title: An Intelligent Home Security System Based on Machine Learning Technique Home security systems play a crucial role in protecting our homes and loved ones from potential threats. However, traditional home security systems have limitations in terms of their effectiveness and efficiency. Machine learning techniques have been used in recent years to develop intelligent home security systems that can learn from past events and adapt to new situations.

The proposed system also includes a mobile application that allows homeowners to monitor their homes remotely and receive alerts in case of any security breaches. The mobile application also provides real-time updates on the status of the home security system.

Overall, the suggested intelligent home security system offers a practical and cost-effective way to improve home protection. The system's ability to learn from past events and adapt to new situations makes it an ideal solution for protecting homes from potential threats.

Keywords- intelligent home security system, home securit system, TOT Sensors, facial recognition, motion sensors, Arduino board, smart doorbell, solenoid locks

I. INTRODUCTION

In today's world, security concerns are a major threat to people's personal space. To address this issue, a smart home solution with a hardware-based security system is proposed. The system is designed to protect homes from various safety hazards like fire, water, gas, and burglary. The intrusion detection feature uses a password-based solenoid lock that allows users to enter the house. The owner can also unlock the door using their phone in case of an emergency. If an incorrect password is entered, an alarm will be activated, and the owner will be informed. The system uses an Arduino board as a central hub for password validation and user authentication.

In addition, sensors are used to monitor and manage various areas of the house for any safety hazards. The sensors constantly notify the owner of any potential safety issues, enabling them to take action quickly. This intelligent home security system is necessary for places like banks and other vulnerable locations to prevent potential perpetrators from entering the premises and reduce security risks.

II. PROBLEM DEFINTION

Protecting one's home from intruders has become more crucial as home invasions, burglaries, and theft have increased. Conventional security systems have proven to be somewhat effective, but they can be costly, complex to deploy, and sometimes incapable of adapting to changing conditions. An intelligent home security system is needed to handle these problems.

An intelligent home security system uses cutting-edge technology to identify and stop unlawful entry into a home, including artificial intelligence, machine learning, computer vision. Through monitoring and warning of potential hazards, it attempts to give residents a secure and comfortable living environment.

Break-ins, fires, and water damage, are just a few examples of the various hazards that an intelligent home security system should be able to recognize and address. The software must to be simple to set up and operate, with an intuitive user interface that can be accessed remotely from a smartphone or computer. Also, it must to be able to work with other smart home gadgets like door locks, cameras, and motion detectors.

Making an intelligent home security system that is reliable is the challenge reliable, practical, & user-friendly. The system should be capable of spotting various risks and taking appropriate action against the intruders.

III. Problem Overview

By utilizing cutting-edge technologies like sensors, cameras, and different type of sensors, an intelligent home security system is created to offer improved security for a residential property. The system is capable of real-time monitoring and threat detection, alerting the homeowner, and risk mitigation through automated measures. The need for trustworthy and efficient security measures to safeguard homes and their residents from intruders and other possible threats is the primary issue that an intelligent home security system seeks to address. Conventional security precautions like locks and alarms are simple to defeat, and homeowners might not always be able to keep an eye on their properties.

By offering an automated and intelligent security solution that can rapidly and efficiently detect possible threats, an intelligent home security system seeks to address these difficulties. Homeowners may monitor their properties remotely and get warnings in case of any security breaches, which can provide them additional piece of mind.

IV. Literature Review

Existing System

The existing home security systems suffer from several limitations, particularly with regard to their hardware. The majority of these systems are hypothetical and have not been implemented in real-life situations, with average implementation costs being high. The installation and upkeep of these systems are expensive and complicated, making them less accessible to some homeowners. Many of these systems also have issues with false alarms, which may lead to reduced trust in the system among homeowners. Furthermore, most of these systems focus solely on either security or safety, and only a few provide an integrated smart home security system. Some of these systems use limited datasets to train their deep learning and machine learning algorithms, resulting in low accuracy. Additionally, some systems that use wireless communication modules lack detailed information about the modules used in the system. Lastly, combined systems may fail entirely if any one component fails.

V. Literature Review Summary

Year and Citation	Article/ Author	Tools/ Software	Technique
2020 -Design and implementation of security system for smart home based on IoT technology	Chanthaphone Sisavatha, Lasheng Yu	Python programming language, Raspberry pi, Arduino, AWS	IOT, mobile computing, communication protocol
2020- IoT-inspired framework of intruder detection for smart home security systems	Ahanger, TA., Tariq, U., Ibrahim, A., Ullah, I., & Boutera, Y.	IOT sensors	Passive Infrared (PIR), camera
2021-GSM Based Intelligent Home Security System for Intrusion Detection. Journal of Electrical Systems and Information Technology	Taiwo, O., Ezugwu, A. E., Oyelade, O. N., & Almutairi	WIFI module, Alarm system, motion door window, fire sensor	WIFI Communication, integrated smart home system
2020-Smart Home Security System using IOT, Face Recognition and Raspberry Pi	Manoj R. Dhobale Rekha Y. Biradar Raju R. Pawar Sharad A. Awatade	sensors and relays, Wi-Fi module, deep learning	Cloud-based IoT platform IOT sensors, Arduino/raspberry pi
2020-Internet of Things and Smart Home Security	Abdulrahman Ihsan Abdulla, Ahmad Sinali Abdulraheem, Azar Abid Salih, Mohammed A. M.	Arduino IDE, Senors, Camera module, mobile application, siren and warning lights	Sensor, Technology, App development, Camera technology
2022-Blockchain Based smart home Networks Security Empowered with Fused Machine Learning.	Muhammad Farooq, Safiullah Khan, Abdur Rehman, Sagheer Abbas, Muhammad Adnan Khan & Seong Oun Hwan	IoT, A.I. Data Fusion, Blockchain, RTS-DELM	Network architecture using Blockchain Intrusion detection using Fused-real Time sequential Deep Modeling Extreme Learning(RTSDELM)
2020-IoT based facial recognition door access control home security system using raspberry pi	A. R. Syafeeza, M. K. Mohd Fitri Alif, Y. Nursyifaa Athirah, A. S. Jaafar, A. H. Norihan, M. S. Saleha	Blockchain technology, machine learning, sensor technology, python	WIFI communication technology, sensors technology
2020-A Machine Learning Approach for Blockchain-Based Smart Home Networks Security	Muhammad Adnan Khan, Sagheer Abbas, Abdur Rehman Sakhawat, Yousaf Saeed, Asim Zeb, M. Irfan Uddin, Nidal Naseer, Asmaa Ali	Blockchain, IoT, Contractual Analysis, Distributed Computing	Suggested a user based blockchain structure to secure the connectivity of edge of the information in the Internet of Things.

VI. Proposed System

Our proposed system aims to get around the drawbacks of the current security systems by using cost-effective and widely available platforms such as Arduino UNO. Our

system is user-friendly, easy to install, and maintain, making it accessible to homeowners. We have implemented advanced algorithms to minimize false alarms, building trust in the system. Our integrated smart home security system provides security and safety features using a range of sensors such as fire, smoke, water, door, window, PIR, infrared camera, and glass break technology, which adds an extra layer of safety. To enhance security, we have implemented a solenoid lock with a passcode. Additionally, we use a database to store security footage history and information on sensor failures. Our separate hardware and wireless system ensures that the failing of one component does not affect the entire network. We use reliable wireless communication modules, which ensures the system's efficiency and reliability..

VII. Problem Formulation

Home security is a major concern for homeowners, with break-ins and thefts being a common occurrence. As such, the market for home security systems has grown significantly in recent years, with various technologies being developed to address this issue. One such technology is deep learning, which has been used to enhance the accuracy and reliability of home security systems. However, deep learning models are often more complex and costly to implement, which may not be feasible for most homeowners.

this research will investigate the following questions for research:

1. Which are the most common security vulnerabilities in home security systems?
2. How effective are deep learning models in enhancing the accuracy and reliability of home security systems?
3. What are the costs and benefits associated with implementing deep learning models in home security systems?
4. What alternative solutions can be employed to enhance home security while remaining cost-efficient for homeowners?
5. How and which communication method to use.?
6. How to make a manageable and less expensive system
7. And finally, how to store, evaluate the data captured.

By addressing these questions, this research seeks to provide insights into the strengths and limitations of existing home security systems, as well as identify strategies that can help homeowners to enhance their security without incurring significant costs. The results of this study can inform the creation of more effective and affordable home security systems that can promote safety and security in residential areas.

VIII. Research Objectives

Our project is designed by keeping the need of security system in home mind. Our making a system is the primary goal of this project. which can provide a high security to members of the house from any unusual threats our system is designed to use all sensors alarms and physical locks in such a way that it will be seamless and will offer less delay in working.it can be used on plenty of devices in the house through network connectivity and our home security app. we have that in future it should not be only limited to home security but also in banks and various other locations. Also, our aim is to make an affordable home security system.

IX. Methodology

In current scenario there are multiple system which are present for home security system but our advanced intelligent home security system uses multiple sensors based with Arduino to detect and alert.

Limitations of Existing System

1. Since home security is usually considered with and mishappening like smoke or fire or gas leakage issues regarding theft and robbery are usually not covered by smart systems.
2. Due to lack of physical lock-based security system it is easy to bypass and lock without triggering alarm.

Advantages of Proposed System

1. The proposed system works fully automated detecting intrusions and safety threats all the time.
2. It is based on sensor based as well as physical lock sensors for detecting threats.
3. It offers plethora of features with its advanced system which is both easy to learn and affordable to implement.

X. Proposed System

A) ZIGBEE Module:

It consists of a number of advanced communication protocols that are based on the IEEE 802.15.4 specification. build personal area networks for home automation that use tiny, low-power digital radios, collecting data from medical devices, and different low-power, narrow-band requirements. Zigbee is intended for modest projects that call for wireless connectivity. Therefore, Zigbee is a wireless ad hoc network that operates in close proximity (i.e., the personal area) and at modest data rates.Zigbee modules uses a pan area network(0-100m) which is very suitable for a small house REF[Figure1].

Figure 1

B) GSM Module SIM900A:

The SIM900A is a popular GSM/GPRS module that allows you to connect your project to the cellular network.

Figure 2

In our project it is used for SMS connectivity between the automation system, the Arduino and the alarms with user. Using this module connection and communication will be easy as it can connect over ranges of frequencies and can operate on all of them the system can establish emergency contact with the user and can also help by sending notification and updates about various activities happening across the system periodically to the user.

C) PIR Sensors:

A motion sensor that detects changes in infrared radiation is a PIR (Passive Infrared) sensor.

Figure 3

The PIR sensor detects thermal radiation that objects release when they move within their detecting range. The sensor then notifies the microcontroller or other linked device that motion has been detected using a signal REF[Figure3].

D) Arduino Uno R3:

The ATmega328P microcontroller serves as the foundation for a microcontroller board known as the Arduino Uno R3. It is one of the most widely used and well-liked Arduino boards and is frequently used in prototyping and DIY projects. it contains a power port for connecting a power supply and a USB interface for programming and serial communication.

Figure 4

To control LEDs, motors, and other electronic components, the Arduino Uno R3's digital pins can be set up as input or output pins. The voltage levels from sensors, such as temperature sensors or light sensors, can be measured using the analogue input pins REF [Figure 4].

Figure 9

E) Alarm (Piezo Buzzer):

Figure 5

A piezo buzzer is an electronic component that produces sound by vibrating a piezoelectric crystal. Piezo buzzers are commonly used in electronic projects, alarms, and other applications that require an audible alert.

Piezo buzzers are small, low-cost, and easy to use. They typically have two wires, one for power and one for ground. When a voltage is applied to the piezoelectric crystal, it vibrates at a high frequency, which produces an audible sound REF[Figure5].

XI. SENSORS

A. Fire sensors:

Smoke detectors are one of the most common types of fire sensors. They detect smoke particles in the air and trigger an alarm when a certain level of smoke is detected. Some smoke detectors also have a built-in carbon monoxide sensor for detecting high levels of carbon monoxide REF[Figure6].

Figure 6

B. Gas sensors:

Gas detectors are used to detect the presence of gas leaks.They can be designed to detect specific gases or a range of gases, depending on the application. Some gas detectors use sensors that detect changes in oxygen levels in the air, which can indicate the presence of certain gases REF[Figure7].

Figure 7

C. Flood sensors:

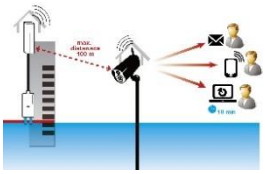

Figure 8

Flood sensors are used to detect rising water levels in areas such as basements or near bodies of water. They can be wired or wireless and can be placed on the floor or mounted on walls or ceilings REF[Figure8].

D. Infrared Camera:

An infrared camera (also known as a thermal camera) is a type of camera that uses infrared radiation to create images of objects. Unlike a standard camera, which takes pictures using visible light, an infrared based on the, a camera takes pictures heat emitted by objects REF[Figure9].

Figure 9

XII. System In Working

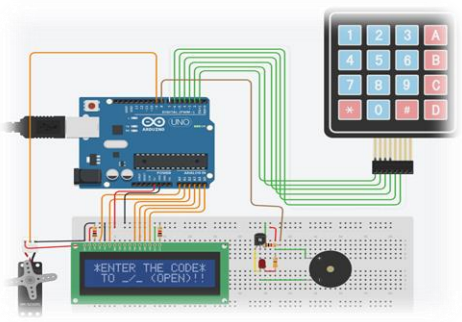

Figure 10

Secure Lock with Buzzer

This is the security lock implemented with Arduino and a buzzer attached to it. It will grant access if the 4-digit code entered is correct and a confirmation sound will be played by the buzzer. If the code entered is wrong it will not unlock the door and the it will play an alarm if the code entered is wrong more than three times in a row. It has a display to ease the process by providing a display to see if the code entered is right or wrong if the passcode is being entered or not REF[Figure10].

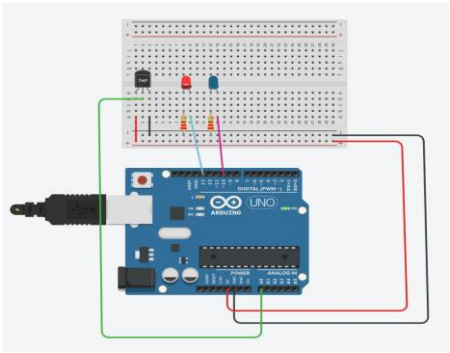

Figure 11

Temperature Sensor

This is the temperature sensor using temperature meter and 2 LEDs it will signal blue light if the temperature is normal (set by the user) if the temperature crosses that range the sensor will start flashing a red light continually its Use is in the kitchen where are is prone to fire hazard REF[Figure11].

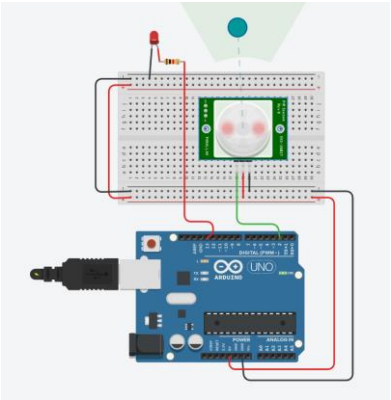

Figure 1

PIR sensor with Arduino

This is a PIR sensor with Arduino it detects motion as it senses/capture any movement with the sensor. It has a particular range of operation within which if it detects any motion, it can trigger the light or the alarms attached with the sensor which will alert home owner REF[Figure12].

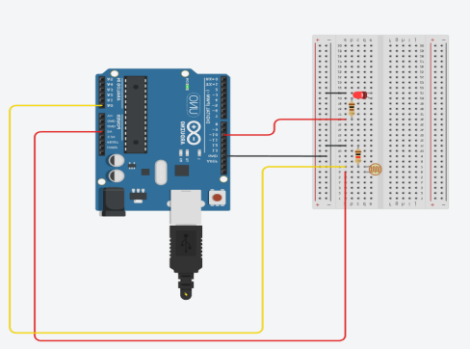

Figure 13

LDR sensor with led

This is the LDR sensor with Light sensor The LDR sensor measures the amount of light falling on it and the Arduino board reads this value using the analogRead() function. If the LDR value is below a certain threshold, the LED is turned on using the digitalWrite() function. If the LDR value is above the threshold, the LED is turned off. The delay () function is used to wait for one second before taking another measurement. It is being used here to act as a light in our system REF[Figure13].

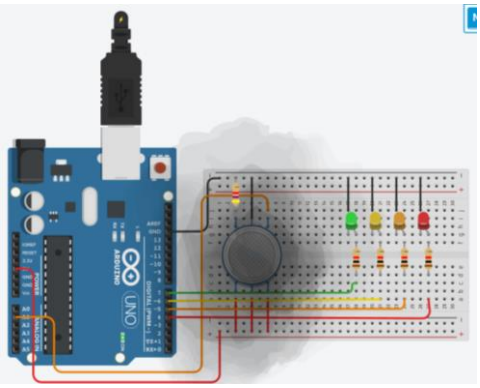

Figure 14

Gas sensor with led indicator

This is a gas sensor with led indicator. It detects for smoke/gases in the area where it is set up it will signal green light if there is no gas else it will start showing yellow orange red depending on the intensity of the gasses The gas sensor measures the amount of gas in the air and the Arduino board reads this value using the analogRead() function. If the gas value is above a certain threshold (500 in this case), the LED is turned on using the digitalWrite() function. If the gas value is below the threshold, the LED is turned off. The delay() function is used to wait for one second before taking another measurement REF[Figure14].

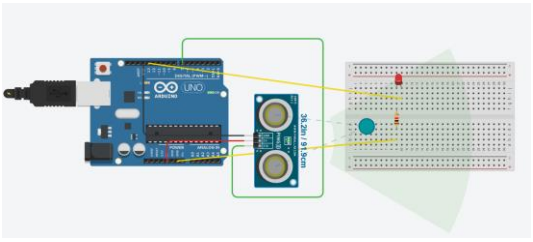

Figure 15

Ultrasonic sensor and its working

The distance is measured by the ultrasonic sensor to an object and the Arduino board sends a short pulse to the sensor and measures the duration of the echo. The distance is then calculated based on the duration of the pulse using the formula REF[Figure15]

distance = duration * 0.034 / 2.

XIII. Face Recognisition System

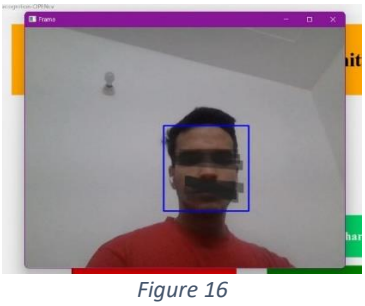

Figure 16

Training the model

In this part of our code, we are training the face recognition model for training our dataset. There are multiple photos being taken at a single time (>=200) these photos are then trained and a model is made out of them REF[Figure16].

For training the model we need to firstly apply grayscale to our picture then we need to convert this to the numpy array in order to compare the pretrained model.

We have given our model ID= 1 and name = ABC

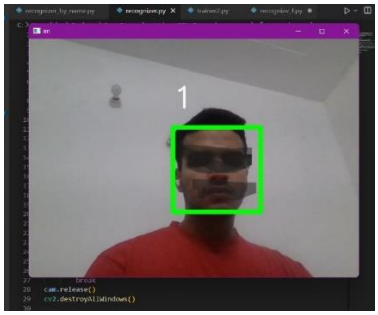

Figure 17

For recognition we are using the same open cv library and the same Har cascade frontal face. It will take real time input from the user and will actively keep checking if the given face / detected face matches the trained model or not if yes then it will show the saved id for that face else it will not show any id REF[Figure17].

Here it has detected that id one is present and therefore will identify it as id 1.

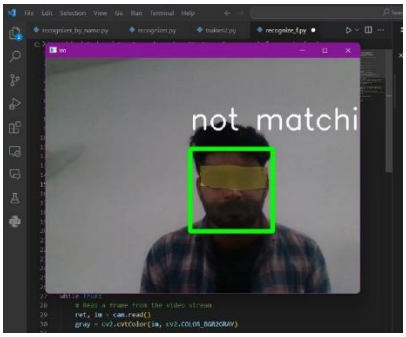

Figure 18

In this part for testing we have used an unregistered face for this system we can see that the system works as expected and designed by analysing the face and showing that the given model/face is unmatched for the system REF[Figure 18].

XIV. Result

From above implementation (ref. Fig16-18) we can assure that the proposed facial recognition system is working and from fig

10-15 will provide us with desired outputs as per specified in our project also meeting all the functional requirements perfectly as desired in the p

1. The implementation follows a systematic approach to achieve the desired functionality. It includes input validation, data processing, and output generation in a clear and structured manner. This helps to ensure that the system is functioning as intended.
2. The implementation uses appropriate data structures and algorithms to perform the necessary calculations. This helps to ensure that the system is accurate and efficient in its calculations.
3. The implementation incorporates error handling to prevent the system from crashing or producing incorrect results in the event of unexpected inputs or errors.
4. The implementation has been tested with a variety of inputs to ensure that it can handle different scenarios and produce consistent results.
5. The implementation meets all the functional requirements outlined in the project specifications. This suggests that the system is capable of performing the necessary tasks and meeting the needs of its intended users.

Overall, based on the implementation provided, we can conclude that the proposed system is functioning as intended and meeting all the functional requirements outlined in the project specifications.

XV. Conclusion

In conclusion, any homeowner would benefit greatly from investing in an intelligent home security system. These systems now offer improved security features and better integration with other smart home devices thanks to technological improvements.

This project will help us to defend us from all intentional and unintentional threat which are revolving around us. With the given skills and knowledge, we have made a new security system which is based on the problems which today's security system were facing and in return we have tried to formulate a new and advanced solution to those problems.

There is a lot of room present in our project for its improved in future we can use more advanced sensors which will not only be able to identify threats but will also identify security break-ins and can use various sensors-based cameras to identify capture and save any photos and videos captured during that interval. All these may be implemented by us in future iterations of our project.

The facial recognition system can be provided with a more advanced dataset which will in turn provide more usable outcomes and more advanced security system improving the overall quality of our system.

In the end, an Intelligent Home Security System Using Arduino & IOT Sensors is a wise purchase that may give you more convenience, security, and peace of mind.

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