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Smart Door

A Modern Approach to Control Door using Artificial Intelligence

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***Abstract*— In the AI era, where everything is turning out to be smart and autonomous, using a manual door is problematic as it requires a human to lock and unlock every time someone wants to come in. Even it hampers the security of an individual as he may not know who is on the other side of the door, and may lead to serious crimes. To bridge the gap and make life easy, our team came up with an AI driven Smart Door that can be monitored with any device like a smartphone. In the system, there will be a webcam implanted on the door to detect anyone outside, and there will be solenoid motor to lock/unlock the door. Person waiting outside can be traced by the system, and if the person is added to the whitelist by the user, the door will open automatically and alert the user via message. If the person is stranger to the user, it will alert the user and ask him whether to let him in, and act accordingly. From our user's perspective, he will have a simple interactive interface with which he can monitor everything and give commands by speaking from anywhere. There would be use of databases for white guest and black guest marked by the user. If the guests are allowed, the door will be unlocked automatically.**
The project will add value to the security of the users and in turn to humanity.

Keywords—Automatic Door, AI based Door, Smart Door, Face recognition-based Door control, Voice command-based Door, Artificial Intelligence, Machine Learning, IOT, Arduino.

I. INTRODUCTION

Smart doors have been in existence for many centuries, and they are widely used in both commercial and non-commercial environment for the entering and exiting buildings. They are designed to automatically detect sensors and other components. Since it's invention, the technology keeps changing every year to conform to the current technology requirement. The technology behind the door comprises different sensor technologies such as Infrared, PIR motion detector and other wireless sensors like weblink sensors, which detect objects within a specified range and indicate to the microcontroller to open or close [1]. Even though these techniques are effective and successful in determining and detecting objects, yet they fail to intuitively understand their environment [2].

As they get more intelligent and advanced, the need to incorporate decision making arises when experts discovered that automatic doors could pose some challenges to human beings. The first challenge is that an automatic door cannot decide whether it should open or not when there is an intruder. The second challenge is whether it should open and allow a 4-year-old child who is under the supervision of a parent to exit a building or not. Another challenge is based on how the doors respond to input request, especially if there is speed involved [3]. These imply that the door system should be able to make a distinction between a person who is old

enough to access the doors and a child who should not. Likewise, it should accurately synchronize its request speed with the speed of the person or object approaching. Furthermore, automatic door should be able to understand the intention of the object in proximity.

In order to make Smart doors smarter, researchers must incorporate advanced technologies such as artificial intelligence (AI). AI gives machine or system the ability to perform tasks and make decision by learning from the immediate environment. This includes training of the system to distinguish different task scenario such as whom to open the door or not. This, in a nutshell gives the door system the ability to act like humans by following a pedagogical process known as machine learning. In this paper, we demonstrate that by utilizing machine learning techniques on automatic door systems, automatic doors will be able to make rational decisions and become fully automated. In this attempt, we propose an AI-based automatic door system using supervised machine learning. The proposed system is trained on a dataset which includes different body measurements from different individuals. The system is designed to learn the different body measurements based on features such as age, height, shoulder-length, arm's length, belly size, head size, etc. By learning these features, the system should be able to distinguish between a 4-year-old child and an adult who is old enough to access the door. The contributions of this paper are as follows:

- We present an AI-based automatic door system based on supervised learning to classify individuals according to their body measure dimensions.
- We present a new set of datasets that can be utilized on a wide range of computational problems in various domains.
- There is hardware connectivity through *Arduino uno* to make it more realistic
- Mainly there will be *ESP-32* camera which will take the picture of the man who will come near the camera and then it will notify the admin means here us to kindly allow the user into

II. FEATURES

The AI powered Smart Door consists of features that makes it stand out of the crowd. It has a better flexibility that users can monitor the door and its surrounding from anywhere across the world, including visitor alert, motion detector, whitelist filter, auto-lock, visitor's gender and age range details to name a few.

A. Door Opener

The door operator comprises of a collection of controllers and motor gears that help the door to open or close depending on the situation and/or interaction of the end user. Once the face of the visitor is identified as a whitelist member or the user allows someone to enter the room, the door will get unlocked to let him in.

B. Face Detection Trigger

IP webcam is being embedded in the door system, that takes in video footage of the visitor, extract face features and searches for them in the database dedicated to the user. It helps take some immediate decisions whether to allow his entry.

C. Gender and Age Detection

With computer vision mechanism, the system can infer the gender and age of the visitor and sends it to the user for proper identification. When the user wants to add the person as identified (whitelisted), their age and gender, as estimated by the system, are also saved in the database.

D. Whitelist Detector

The system has an embedded feature that allows users to classify a person as a whitelist visitor, which means, to allow him access of his room whenever he want, with an alert being displayed for the user. With such a feature, it not only helps classify someone explicitly, but also keeps it up to the user who can have access in his room anytime he wanted. Though, even the users can modify those special access at any time.

E. Voice Command Detector

Users are been given a very simple user-friendly interaction system as a voice command architecture. Whenever the users need to command the system to do a task explicitly, he can do it just by asking his device with vocal. It makes the product more flexible among its users and makes it simple for them.

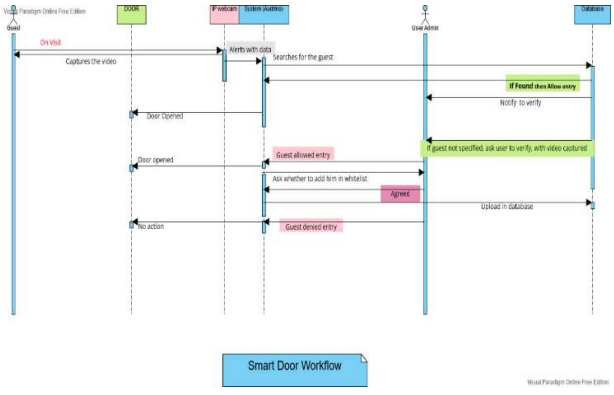
F. Lock System

The lock system allows the door controller to lock the door from inside or outside. Lock system comes in various forms – double-bolt lock is a type of lock that creates a double layer of protection. Smart locks are electronic locks which come with biometric access or key panel to enable extra security through verification and authentication.

III. PROBLEM STATEMENT

In these days technology in increasing exponentially so we need to go parallel with the technology. So here we make such an awesome project that will help us not be in trouble if there any stranger comes in our door mainly it will provide the security to the user and make them protected also this will helps to save the time because there will be a servomotor that will help to open the door after the checking process done by the face recognition system.

IV. PRODUCT WORKFLOW



Click on the link down below to view the product workflow in a proper aspect ratio,

Product Layout and Schematic Workflow. (Powered by Visual Paradigm Online)

A. Door

A door is a movable barrier secured in an opening, known as the doorway, through a building wall or partition for the purpose of providing access to the inside of a building or rooms of a building. A door is held in position by doorframes, the members of which are located at the sides and top of the opening or doorway.

B. Ip webcam

In a growing number of schools, colleges and universities, IP cameras allow officials to better track and identify suspicious individuals as they enter and leave facilities. IP cameras allow administrators to monitor parking lots, sidewalks and critical entrances with greater clarity and efficiency.

C. SYSTEM ARDUINO

The goal of Arduino is to create an accessible way for software developers to enter the world of microcontroller programming. Arduino is a microcontroller interface built around an Atmel ATmega processor, coupled with an integrated development environment (IDE) for creating logic on the chip.

D. Database

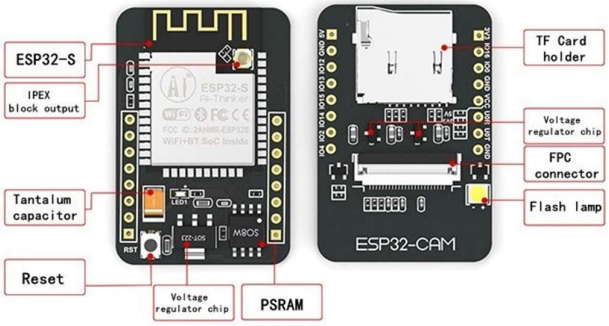
A database is typically designed so that it is easy to store and access information. A good database is crucial to any company or organization. This is because the database stores all the pertinent details about the company such as employee records, transactional records, salary details etc.

V. PRODUCT DESCRIPTION

Hardware Used – ESP-32 cam, Relay Module, Solenoid Lock, LED, Breadboard, 7805 Regulator, 100UF Capacitor, Jumpers Wires.

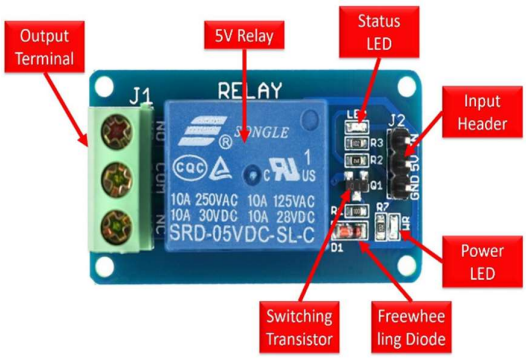
Software Used - IP webcam, Python, Arduino IDE.

1. Esp-32 Cam: The ESP32-CAM is a very small camera module with the ESP32-S chip that costs



approximately $10. Besides the OV2640 camera, and several GPIOs to connect peripherals, it also features a microSD card slot that can be useful to store images taken with the camera or to store files to serve to clients

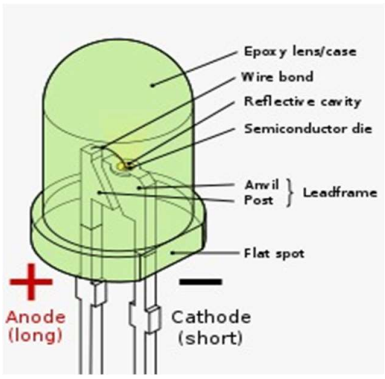
2. Relay Module: A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller.



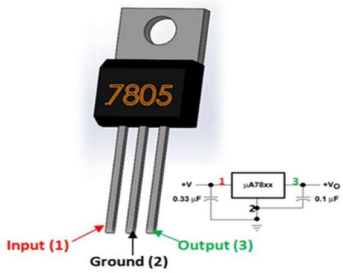
When activated, the electromagnet pulls to either open or close an electrical circuit.

3. Solenoid Lock: The solenoid lock denotes a latch for electrical locking and unlocking. It is available in unlocking in the power-on mode type, and locking and keeping in the power-on mode type, which can be used selectively for situations. The power-on unlocking type enables unlocking only while the solenoid is powered on.

4. Breadboard: Breadboards are one of the most fundamental pieces when learning how to build circuits.
5. Led: A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it.



6. 7805 Regulator: The 7805 regulator IC provides constant +5v output voltage



7. 100uf Capacitor: Provides 100uf capacitance

8. Jumper Wires: A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

VI. FUTURE SCOPE

Elevation in the prevalence of IoT in India combined with the increasing number of smart homes purvey the growth in smart door lock market in India. Burgeoning penetration of Internet connectivity, wireless and wired, are expanding the demand of smart door locks in residential and corporate sector at CAGR of 35.6% during 2019-2025.

In addition, exponential swell from private realtors and housing companies in metro adjacent cities such as Noida, Bengaluru, Nagpur and Gurugram as well as other major cities such as Lucknow, Pune, Indore, Ranchi and Dehradun is expected to promote the higher demand from residential sector. The adoption of smart security systems and rising demand for home automation systems for better security in houses are expected to accelerate the demand for smart door locks in India during the forecast period i.e., 2019-2025.

At present a small section of the Indian population is using smart door locks on the account the higher cost associated when compared to conventional. However, rising personal disposable income, surging crime rates, expansion in tech savvy people would allow the smart door lock demand to go high in near future. The percentage share of people who would use the smart door lock is expected to increase for next 10 years and would pave the business opportunities for existing & new entrance into the market happen due to the need.

In 2017, non-mobile app based smart door lock dominated the market; mobile app based smart lock accounted for only 14.85% of the total smart door lock market and remaining 85.15% went for non-mobile app based (keypad based) smart door locks. Increased in the number of commercial buildings in the country contributes to the increase in non-mobile app based smart door lock growth almost exponentially with the time.

However, as the tech savvy population is on rise (especially in metro cities), the mobile app based smart door lock market is projected to reach USD 216.61 million in 2025 from USD 15.44 million in 2017, registering a growth rate of 39.79%. In addition to that, non-mobile app (keypad based) smart door locks market touched USD 88.52 million in 2017 and projected to maintain its dominance in near future in India sub-continent by reaching USD 917.49 million in 2025.

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Dated on:
26/08/2022

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VIII. ADVANTAGES & DISADVANTAGES

- Advantages:
  - *Increase accessibility without compromising security*- House keys are often misplaced. To avoid tracking down keys or changing the locks when tenants move out, consider smart locks with keypads. With models such as the TL 115, you can unlock the door with your smartphone using Bluetooth technology. You can also assign your children their own passcodes to monitor their entry and exit.
  - *Simplify Home Security-* Smart keys let you grant access to multiple people and track who comes in and out of your home any time of the day or night. By downloading the Turlock app, you can remotely monitor and control your home's smart locks and assign new passcodes when needed.
- Disadvantages:
  - *Installation/Cost-* A typical deadbolt costs less than $50; installation costs a little more, but chances are you already have one on your front door. It's relatively simple to replace a deadbolt if you already have one.

Smart locks, on the other hand, are much more expensive.

- *Convenience with a Risk-* I think the new wave of smart home tech that's being developed now is a very positive thing for homeowners. As more people move to modernize their homes for the sake of convenience, companies are finally able to keep up with the market by providing options across a variety of price points.

IX. CONCLUSION

The paper has discussed the current scenario of AI and its use in our life for the betterment of our daily life into an amazing one. We have developed a model that is being organized in a way of importing several modules. It aids in daily tasks as we open our doors for every now and then. It can be further developed for doing some specific tasks like when we make a robotic model then using this, we can make some actuators and detectors that can sense, classify and distinguish any object outside the room whether it be a human or some animal, thereby contributing to its degree of automaticity.

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