Creation of a New Home Security System Using IoT Devices

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**Abstract** — This project presents the design and implementation of a moderately low-cost smart home door security system using IoT devices. This report will outline the devices used and why each was chosen compared with alternative devices for each situation, an outline of the rough costs for each component needed to create the device, pseudo code, diagrams to show logic and data flow within the device and a final implementation made with available devices including a reflection on how the project went.

**Index Terms** — Internet of Things (IoT), home security, ultrasonic sensor, ESP32-CAM, smart devices, motion detection, real-time notification, intrusion detection, image capture, buzzer alarm system, pseudocode, logic diagram, smart home, design, implementation.

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# 1 Introduction

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onsider a scenario where someone attempts to break into a home. Without an effective home security system in place, it may go undetected. This is a reality many people face. With a house being broken into approximately every 173 seconds in 2023/24[1] home security is becoming an increasing concern for UK citizens. Due to this IoT based smart home devices are gradually becoming more popular among the public with approximately "one in five Brits now own[ing] a video doorbell"[2] this rise in popularity is primarily due to the increased capabilities and affordability of these devices.

Many traditional home security systems can either be expensive or complex to install and many low-cost alternatives lack the capabilities to be truly effective. This demonstrates the need for a simple, effective home security system which will not be overly expensive.

This is where a simple system which can be installed at any door in a property can come in useful. The system will include a sensor to detect when a door opens and use a camera to snap a picture of the intruder before sending a notification to the user’s phone and then waiting for a bit to allow for the person to input a pin before setting off an alarm. This device is meant to scare the intruder to stop them from entering while still ensuring that they get caught due to the image capturing capabilities.

# 2 Details of the design

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he system can be split into three sections:

Firstly, there is the trigger mechanism which will be made up of a tilt sensor rigged up to the door to detect a change in the angle and send a signal to the next section of the device. This was chosen as opposed to the other options, such as a button positioned such that when the door is fully closed it would be pressed and when opened it would stop pressing the button due to while being effective it would be difficult to implement reliably, or an ultrasonic sensor aimed at the door so when it moves the sensor which would be difficult to implement without it triggering a lot of false alarms.

Secondly, there is the camera and notification using the ESP32-CAM which will wait for a few seconds to allow for the door to be fully opened before taking a picture and sending it to the user's phone as a notification. The ESP32-CAM was chosen over the other option which would have involved using a ESP8266 and an OV7670 camera module due to the ESP-32 being faster and having more memory and the OV7670 not supporting compressed images and offering lower resolution as opposed to the OV2640 (ESP32-CAM)[3].

Lastly, there is the alarm where it will then wait for a bit longer to allow the person a chance to input a pin on a membrane switch module to shut off the alarm which will use a buzzer and will trigger if the pin is not put in in time. However, the buzzer will still go off if the pin is input after the timer is over. The membrane switch was chosen over alternatives such as a 3x4 matrix array keypad or an Interfacing AS608 Optical Fingerprint Sensor Module due to the membrane switch and keypad being very similar devices and the membrane switch being easier to use for users as the user does not need to go through the trouble of setting up a finger print scan for anyone who is allowed in as opposed to telling them the PIN for the membrane switch. And the buzzer was chosen over alternatives such as a speaker as it is unnecessary to use a speaker as opposed to a buzzer due to not requiring the extra functions provided by the speaker.

## Cost

Tilt sensor - £5.90[4]

ESP32-CAM - £3.13[5]

Membrane switch module - £3.16[6]

Buzzer - £0.48[7]

Flat Ribbon Cable 6 meters - £5.99[8]

Breadboard - £1.62[9]

Total - £20.28

## Pseudo-code

### Arduino

*#include tilt*

*#include cam*

*#include keypad*

*#define TILT\_PIN = 2*

*#define email Sender Account*

*#define email Sender Password*

*#define smtp Server*

*#define smtp Server Port*

*#define email Subject*

*# define email Recipient*

*#define Camera model*

*Const char ssid*

*Const char password*

*Const byte rows = 4*

*Const byte cols = 4*

*Char hexakeys[rows][cols] = {*

*Buttons on keypad*

*}*

*Byte colpins[rows] = 5, 4, 3, 2*

*Byte rowpins[cols] = 9, 8, 7, 6*

*Initialise keypad*

*Void setup ()*

*pinMode (TILT, input)*

*Wifi.begin*

*pinMode (Buzzer, output)*

*Void loop ()*

*Int TILT\_VALUE = read(TILT)*

*If TILT\_VALUE = low*

*Delay (3000)*

*Auto img = esp32cam::capture*

*Send email (img)*

*If (key pressed = #)*

*If pad = password*

*End*

*If pad != password*

*Digital write (Buzzer, high)*

*Void read keypad() {*

*Key pressed = get key*

*If key pressed != #*

*String konv = string(keypressed)*

*pad += konv*

## Logic diagram

A flowchart of a photo

AI-generated content may be incorrect.

A flowchart of a photo

AI-generated content may be incorrect.

# 3 Implementation

Due to hardware limitations for this implementation, it instead used an ultrasonic sensor as an alternative to the tilt sensor, an Arduino board with an ESP-82666 for Wi-Fi connection and a laptop webcam instead of an OV2640.

# 4 Discussion and conclusion

# 5 References

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