IoT & AI Based Smart Doorbell System

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Abstract: In daily life, people have the need to know the identity of a visitor who comes to their organizations, regardless of whether they are there at that time. This need is even greater for people who suffer from some kind of disability that prevents them from meeting the visitor. To provide a solution in this sense, this paper proposes a smart model that performs the task of a doorbell, which should recognize the visitor and alert the user. To achieve that, this proposal incorporates technologies for facial recognition of visitors, notification to user and management of their responses. The complete process .i.e. recognition of visitor and notification to user and the related management problem divided into interrelated stages and their standardization issues are discussed later . Finally to test the effectiveness of the model, three scenarios where integrated; each one was composed by different organizations over which the recognition of known and unknown individual was analyzed. The system is based on the criteria of low power consumption, resource optimization, and improved operation speed.

IndexTerms **– Internet of Things, Face Detection and Recognition in Azure, Smart Doorbell, Arduino, security, Thingspeak, Kairos, Microsoft Cognitive API.**

I. Introduction

The human face has a particular shape that requires complex calculations in order to recognize it. Individuals are distinguished by their faces, with which they are being identified. The face recognition systems are embedded very practical to be used in different applications, such as terrorist's identification, security systems and identity verification access. In fact it is implemented in many public and even dedicated areas. Thanks to well develop technologies to the computer science, we can obtain considerably good and satisfying result of face identification and reveal. The extracted detail from faces will be analyzed and compared with the already existing similar face operated details in the Thingspeak database.

The different domains have been proposed to classify IoT applications; the model described in this paper aims to two of them. The first is the "smart home" domain and the second refers to "independent living" domain [1]. Combining those domains we have a home automation IoT application oriented for the elderly and disabled.

In this paper, face recognition is initiated by pressing the doorbell button. Indeed, an integrated web camera will captured several pictures of the visitor. The face recently scanned will be verified in the present database. In case of unknown face, a message with captured image is generated and pop at the owner screen. Otherwise, in case of known face, actual face id is matched with face id's which is already stored in database and door will automatically open's for few seconds. Furthermore, the owner will be notified through his device connected with system. Comparing to old face recognition systems that are already commercialized, this project is more efficient in real time response with better recognition rate.

Abbreviations and Acronyms

IoT -Internet of Things.
AI –Artificial Intelligence.
API -Application Programming Interface.
ICT Information and Communication Technologies.
USB -Universal Serial Port.
SDK- Software Development Kit
LED- Light Emitting Diode
ESP-Electronic Stability Program

II. RESEARCH METHODOLOGY

since 2015 the industry has seen a drawn of work being done in fields of Artificial Intelligence, Machine Learning, IoT, Big Data Analytics all with common goals to make things easier, self-supervising and to interconnect all kinds of devices by making everyday objects interconnected and interoperable.

A need has been failed in the field of digitalizing conventional security tools and thus a lot of work has being modelled on making daily life locks smart by introducing locks movable with the help of servo motor and adding a digital number pad to take input from user or adding InfraRed or Bluetooth modules to operate these devices.

An intensive study of literature implementing Enhanced Smart Doorbell System Based On Face Recognition[1] in which the face detection done with the help of haar filters which is tough to implement. The fault in existing models is complexity of the system unnecessarily relaying on extra procedures for face detection. Also literatures a regarding Smart Doorbell : An ICT Solution To Enhanced Inclusion of Disabled People[2] have been thoroughly review have complexity of slow processing, which also include unnecessary work.

Our model is unique with its one of a kind combination of functionalities offered and the simplicity of the model. A major difference is in the overhead reduction by an application as it detect the face out of the images and directly open the door in case of identified user otherwise it send the image directly to application program interfaced with our application, which has not been provided in existing model also it is cost effective. Here we avoided the use of unnecessary components like stepper motors and drivers as done in existing model. Also rather than using a low quality Raspberry Pi interfaced camera we have choose USB attachable HD camera to do efficient and reliable facial recognition.

The objective of the proposed work is to implement a working model of smart door and to give a solution to the problem faced by people in day to day incident of burglary and also to promote and ignite the work being done on IoT systems and implanting it with the help of key research areas of Neural Networks and IoT APIs and protocols.

III. PROPOSED SYSTEM

3.1 Design Concept

The main goal of this work is to create an intelligent doorbell system mainly based on face identification (1). The face recognition is done by using the inbuilt algorithm for face recognition known as kairos solution which describe as below. In this the node server request for to training the image to the kairos server called http-server. At the kairos server side the processing is done at the manner shown in figure(3.2) and give the response to the http-server as an face ID of an user. Once the image is trained we can request for the recognition of the face each time when user interact with camera for handling the security.

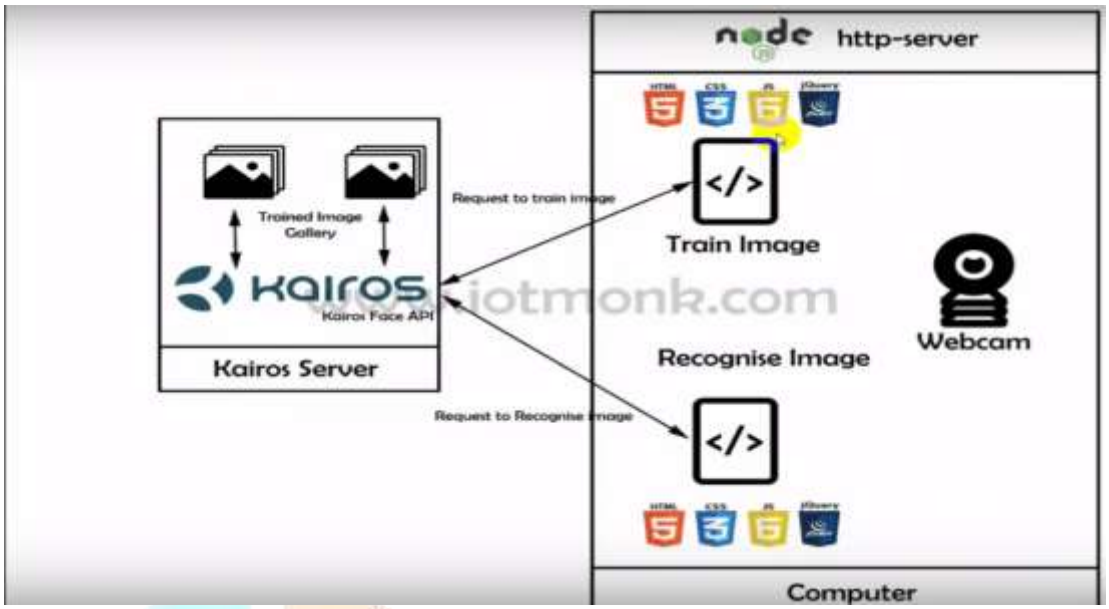


Figure (3.1) Actual working of kairos for training and recognize the image

3. 2 Kairos solution for face recognition

The human face is most accessible way in which we are able to understand who someone is and how they might be feeling, and how someone might feel can give us clues to how they might behave. Data about the face is key to this understanding. Being able to recognize individual faces or reading someone's emotional reaction is often crucial to a business operation. Recognition must be quick and accurate, regardless of whether it is to prevent unauthorized persons from entering a restricted area or to determine customer's feeling about a new product. So far, this has primarily being an assignment for security, marketing staff etc.

The working of kairos is as follows:

The system captures the image of user which is front of camera. The system acquires the all needed information of the person and which are stored in the face images. The preprocessing component is another component which forward the result of acquired image after pre processed it to the characteristics extraction component. The characteristics extraction extracts the information. For example: eye brows, position of nose between the eyebrows, lips structure, accessories, etc.

The characteristic extraction component creates a normalized image and stores a copy on all normalized face to face images normalization. Another task of is to classification of that image characteristics .the training set component creates unique face id of all entries and also which is unique for every person images. This id will store in the database for the further face verification and identification. The characteristics sector stores the information needed for classification of components. After classification the face is identified or the face is known to system or unknown to the system is identified. The face recognition process of kairos are shown in below fig(3.2s) for face recognition:

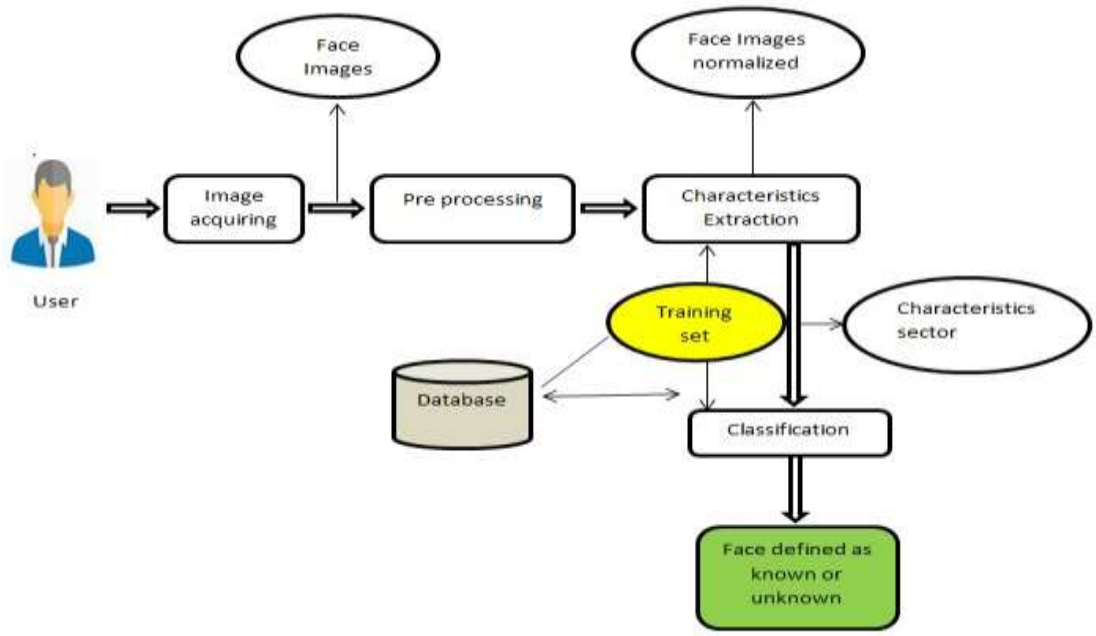


Figure (3.2) working of kairos for face recognition

An automated process for face recognition, based on specially developed software analyzing video streams, from network cameras, not only allows for a faster and more flexible and distributed system but will also improve overall service for a business and customers.

In brief Kairos face recognition

- Auto-corrects for pose and optimizes images for low-light environments
- Insusceptible to facial hair, weight change or accessories like glasses.
- Tracks faces based on the features captured in the first image, without the need to recapture the image each additional time the face shows up.
- Algorithmically learns about a person's face over time, and adapts to each person's unique features and expressions.

Advantages of Kairos

- Proprietary face analysis and machine learning algorithms.
- Multiple delivery options (cloud and on- premise APIs and offline SDKs).
- Long form video analysis and large size image processing is possible.
- Incredibly small facial templates.
- Unlimited face galleries.
- Lightning fast results .
- Facial feature tracking (this outperforms traditional face detection tracking).
- Deeply focused on face analysis.
- Privacy and security assured.
- Designed to simplify and streamline face recognition for developers.

3.3 Microsoft cognitive API

It is an API to Traced –the-face to perform automatic face detection and matching using machine learning, via Microsoft Cognitive services face API. Microsoft started a collaboration on imagine, an image classification pipeline built on top of Azure functions.

Azure function is a framework for a building serverless microservices that can easily support deployed to the cloud Azure function is easily manageable and has built-in scaling. Visual studio support developing Azure function.

The choice to go serverless gave us the flexibility to add or remove function as the pipeline grows. The initial focus was to do general image classification and face detection and matching. The architecture uses message queuing to move images along the pipeline. Each message contains the information needed to move the image to the next step, including the link to the image blob
And collected properties above the image classification. The framework will watch the Azure storage queue this define in the function.jason file for new message and trigger the function when the new message is found.

3.4 Microsoft Face API (Azure)

For face recognition we use already implemented function in Microsoft called as Microsoft Azure. The Microsoft Face API, a cloud-based service that provides the most advanced face algorithms. Face API has two main functions: face detection with attributes and face recognition.

Face Detection:

Face API detects up to 64 human faces with high precision face location in an image. And the image can be specified by file in bytes or valid URL.

Face Recognition:

Face recognition is widely used in many scenarios including security, natural user interface, image content analysis and management, mobile apps, and robotics. Four face recognition functions are provided: face verification, finding similar faces, face grouping, and person identification.

- **Face Verification:**

Face API verification performs an authentication against two detected faces or authentication from one detected face to one person object

- **Finding Similar Face:**

Given target detected face and a set of candidate faces to search with, our service finds a small set of faces that look most similar to the target face. Two working modes; matchFace and matchPerson are supported . matchPerson mode returns similar faces after applying a same-person threshold derived from Face-verify . matchFace mode ignores the same-person threshold and returns top similar candidate faces.

- **Face Grouping:**

Given one set of unknown faces, face grouping API automatically divides them into several groups based on similarity. Each group is a disjointed proper subset of the original unknown face set, and contains similar faces. And all the faces in the same group can be considered to belong to the same person object.

- **Face Identification**

Face API can be used to identify people based on a detected face and people database (defined as a LargePersonGroup/PersonGroup) which needs to be created in advance and can be edited over time.

IV. PROPOSED METHODOLOGY

The architecture for the proposed are shown as following figure(4.1).In order to implement the smart doorbell system we need a list of materials which is briefly mentioned below:

4.1 Hardware:
Arduino
Esp12e
Servo motor
HD Live Web camera
Display Monitor

We can segregate the whole system on the basis of three major functionalities:

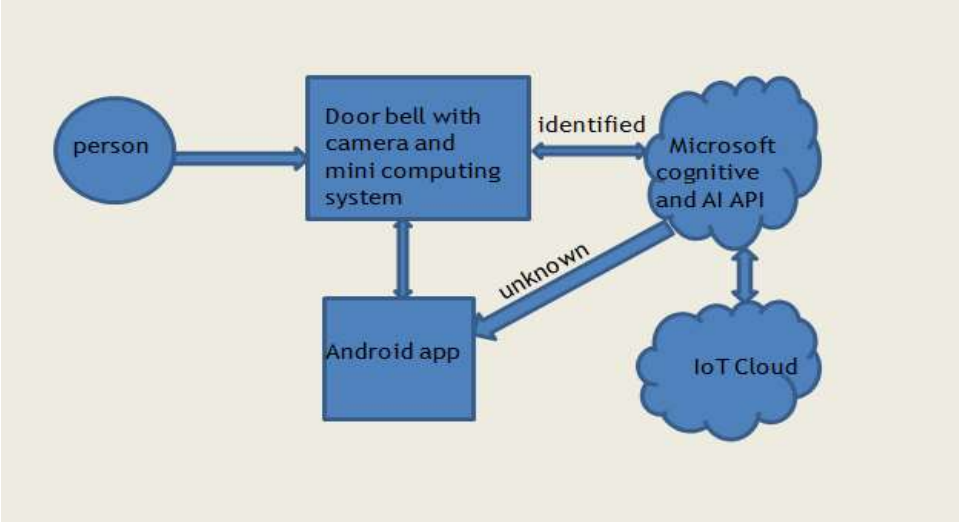
1. Adding user to a database to be recognized from; To add users we need to click on add user button and on doing this, the camera attached captures the image of user sitting in front and ask for name as input, and adds it to the database of images over the cloud from which the face will be recognized.

2. Accessing door on basis of recognition: On pressing the doorbell the HD camera captures the photo and then the application developed detects the face and send it over to the Microsoft Face API interface to the application through Microsoft Azure cloud setup the face is identified and recognized from pre-saved database of facial images on cloud. If the face is matched user then the LED will blink and the processor controlling the relay module opens the door which can be seen by movement of servo motor.

3. In case of unauthorised user the email notification will be generated and send via dummy mail server and the system owner will gave the response at what action to do for the system; to open the door or to remains it close via the user interface connected to system.

4.2 Software:
Microsoft Azure subscription
Microsoft **F**ace API
Things speak
Java script
Html –CSS

To start with first of all we need Arduino set up with windows8, then interfacing the Esp12e microcontroller with the display. The display is attached to a camera interfaced with the microcontroller to provide input of Who accessing the door and to capture the image to apply facial recognition computing via Arduino. The microcontroller is attached with servo motor. Microcontroller is attached with push button, which has the functionality of doorbell.

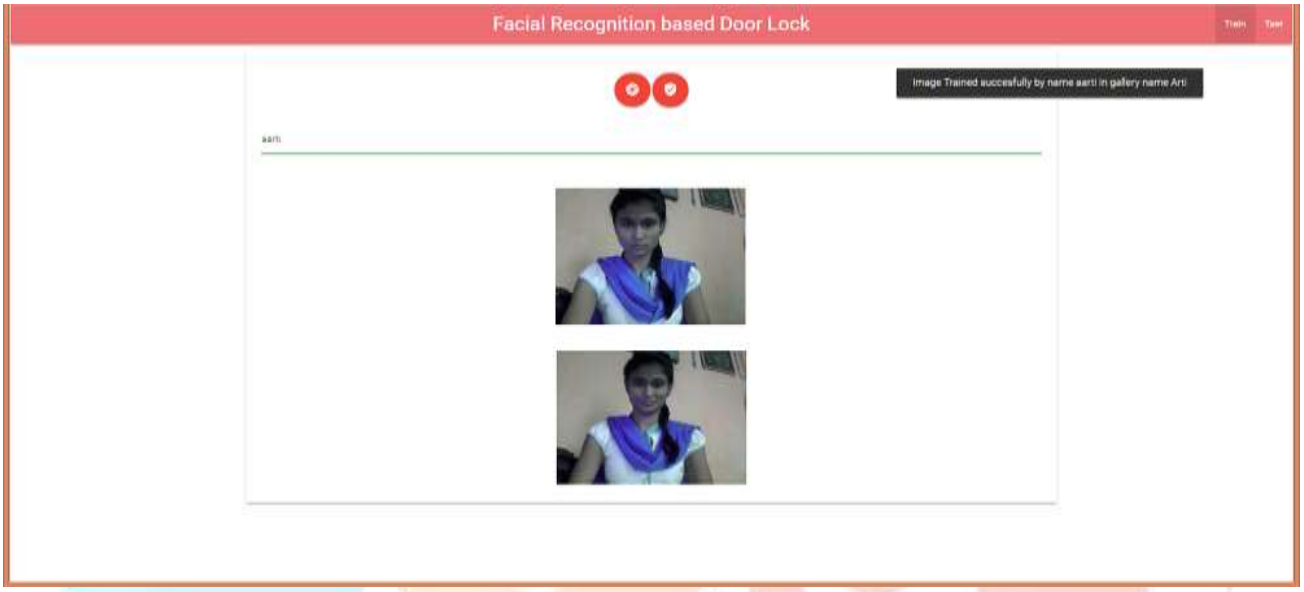


Figure(4.1). Architecture for proposed system

V. RESULT

This project uses the Kairos solution for face identification and Microsoft Azure function for face verification. The program will capture the image with the help of camera connected with system and then apply the required processing for identification and verification.

The two models is used i.e. one for train the image and another for verifying the result which are shown as follows:



Figure(5.1) Train image module

The train module is used training the system with the user. Each user information is stored in a particular image gallery for each time access of the user information. The user name with its id is stored in particular image gallery by their name.

The second module is for test the image for the current user in front of door which are as follows:

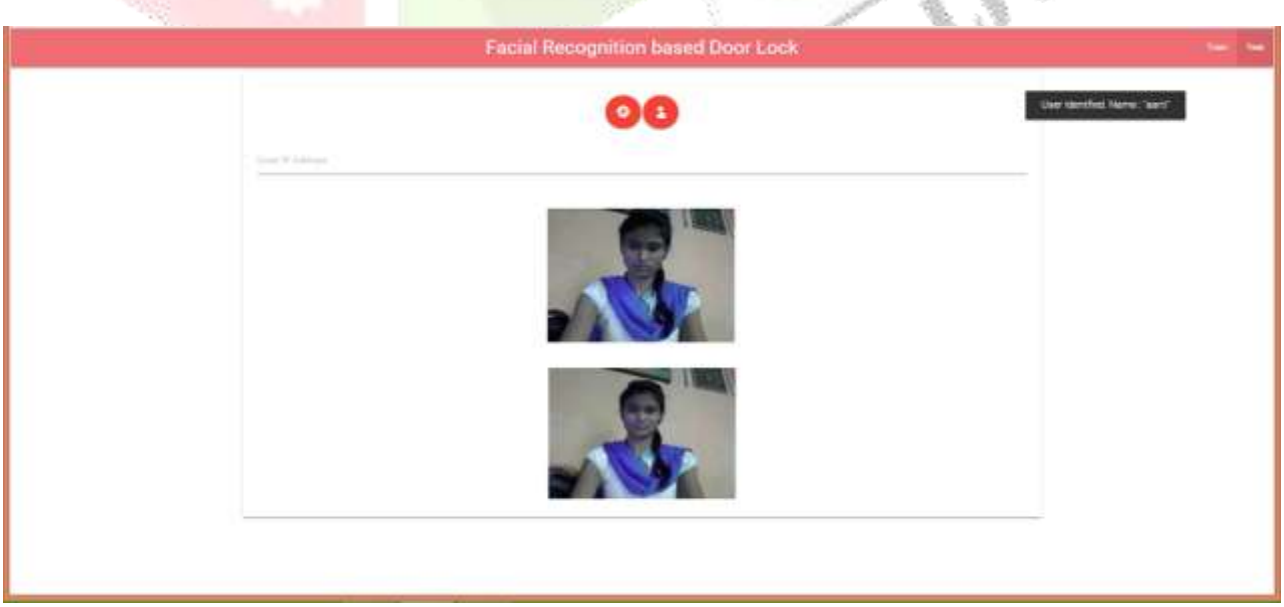


Figure (5.2) User Identification module

The user identification module is the another module for identification of user. At this step the training data is stored in an XML file, which will be loaded by the main software to configure the face recognition model. Once the user is identified then door will automatically unlock for some time then it locks again as shown in below figure(5.3).

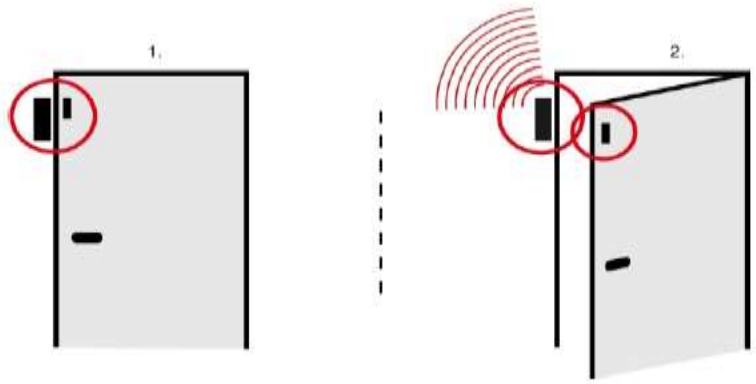


Figure (5.3) door opening after identicication of user with the audio message

The processing time is less for identification, hence the person need not to wait for more time. If the user is not identified the e-mail notification is send to the owners account via internet. The owner then notify with the notification application for the further action. In case of identified user the door will open with the audio message as welcome "user name". For example, here message will be as "welcome Aarti".

VI. ADVANTAGES

1. It is the secure system which solves the problem of security by providing face recognition facility with less processing time for taking further actions to do with user.

2. It is the system which solves the implementation cost issues by using components which solves the problem of cost, which automatically makes the system cost efficient.

VII. APPLICATION OF PROPOSED SYSTEM

The complete system which we developed is mainly used for organizations, industries, home automation, and other area where the security is more important and which is in cost efficient manner. It can be further applicable in other environment where the main focus on the security feature using face detection and recognition based algorithm.

VIII. CONCLUSION

In this work, automatic door access system by using face recognition and detected is presented. Automatic face recognition is done by Neural Network. Arduino controller controls the door access after successful output from the pc. Immediate responses from the door and monitor are observed. The door remains open for definite time and this is suitable for real time. So appropriate time should be set in real time environment. This system can be used in many places where need of security is maximum and security cannot be compromise.

REFERENCES

[1] Ayman Ben Thabet CEMLab, ENIS, University of Sfax,Tunisia,Nidhal Ben Amor CEMLab,ENIS,University of Sfax,Tunisia Lehrstul fur Mess-und Sensortechnik,TU chemnitz,Germany "Enhanced Smart Doorbell System Based on Face Recognization",978-1-4673-9234-1/15@2015 IEEE.

[2] Lucas M. Alvarez Hamann, Luis Lezcano Airaldi, Mariya E.Baez Monlinas, Mariano Rujana, Juliana Torre, Sergio Gramajo National technological University- Resistencia faculty French 414, Resistencia,Chaco,Argentina "Smart doorbell:an ICT solution to enhance inclusion of disabled people",978-92-61-15821-7/CFP1538E-ART@2015ITU

[3] Woo-Hyun Park*,YUN-Gyung Cheong** college of Information and Communication Engineering, Sungkyunkwan university.korea, aimecca@skku.edu,ISBN 978-89-968650-9-4.

[4]Janki venukumar, Naveen. S ,PG student,Dept.of ECE, LBS-Institute Of Technology for women, Trivendrum, India "Aurdino Based Door Access Control".International Journal of Research in Advent Technology,vol.4,no.8,august2016.E-ISSN:2321-9637.

[5]Pushpanjali Kumari,Prathibha Goel,Dr.S.R.N.Reddy,CSE department,IGDTUW,Kashmere Gate,Delhi "IoT Based Wireless Alert System for Deaf and Hard of Hearing",978-1-4673-9777-3/16$31.00@2016IEEE.

[6]Sudhir Chitnis,Neha Deshpande,Arvind Shaligram,Vishwakarma college of Arts,commerce and Science,Pune,India,"An Investigative Study For Smart Home Security:Issues,challenges and Counter Measures",Wireless sensor network,2016,8,16-68.

[7] Karan Maheshwari,Nalini N SCOPE,VIT University,India,"Facial Recognition Enabled Smart Door Using Microsoft Face API",ISSN:2393-9516.

[8]Hteik Htar Lwin,Aung Soe Khine,Hla Myo Tun,"AutomaticDoor Access System Using Face Recognition",Electronic Engineering,Mandaly University,Mandaly IJSTR@2015.

[9]Harnani Hassan,Raudah Abu Bakar, Ahmad Thaqib,Fawwaz Mokhtar,Faculty of Electrical Engineering University,Technology,MARA 40450 Shah Alam,Selangor,"Face Recognition Based On Auto-Switching Magnetic Door Lock System Using Microcontroller,978-1-4673-2376-5/12/$31.00@2012IEEE.

[10]MD.Nasimuzzaman Chowdhury,MD.Shiblee Nooman,Srijon Sarker,"Access Control Of Door And Home Security By Raspberry pi Through Internet",International Journal Of Scentific And Engineering Research,Volume4,Issue11,nov2013,ISSN-2229-5518.