Communication over Internet and GSM using Smart Doorbell
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Abstract—This paper presents the concept of enabling communication between a visitor at the door of a house and its owner in a situation when the owner is not available at home. There are no smart and convenient ways, at present, for the the owner to be notified about the presence of a visitor at his/her door. The world of ‘Internet of Things’ with Raspberry pi at its core allows a fascinating scope to ensure the same. Embedding a standard household doorbell into IOT and GSM network, the system provides a set of features which ensure that no visitor is left unattended or goes unnoticed by the owner of the house in cases when he or she is at work, out of station or just taking a nap on a lazy afternoon. As smarter living is at the core of this project, the system also recognizes and distinguishes the user’s family and friends and therefore does not bother the user with any unrequired notifications.

Key words: GSM, Internet of things, Raspberry pi

I. INTRODUCTION

This project is a significant step towards smart home and living. With the increase in trend of online shopping combined with conventional trends of delivery of official documents through parcels, couriers and so on, we realized that a major inconvenience is faced by the customer as well as the delivery person if the concerned one is not present at his home at time of delivery. This also extends to friends and relatives who may visit your place unannounced.

Thus the two fold problem identified is as following:
- There is no smart means through which the owner of the house is notified about the visitor in case he is outdoors or unable to hear the bell.
- There is no smart means through which the owner of the house can communicate and pass instructions to the visitor at the door.

Using the microcomputer,’Raspberry pi’, the smart doorbell ,hence solves the problem of visitors remaining unattended in case the concerned person is not available. This smart doorbell alerts you when the bell is rung and lets you see and speak with visitors from your smartphone, anytime and anywhere.

On clicking the doorbell, the following form of notifications can be sent to the user’s mobile app:
- A phone call to the user enabling a two way communication between user and the person at the door. The call will be activated using the GSM module connected to the pi. A microphone and a speaker interfaced with the system facilitates the voice communication between the two persons.
- A snapshot of the person at the door. A script written in python is used to capture the image using the compatible webcam interfaced with the pi and to attach and send it to the user through mail.
- A text message with current time will be sent to the user using the GSM module.

The system also includes an inbuilt ‘Face Recognition’ module to distinguish between a known and unknown visitor and hence accordingly enable or disable notifications based on the user’s preference settings.

II. LITERATURE SURVEY

A. Comparative Analysis :
A comparative analysis was performed for the cost and features between some of the systems in similar domain already available in the market and the system proposed in this paper. The analysis shows that the proposed system encapsulates the features which are not found together in any of the available product. Moreover, the available products do not use Face Recognition and hence do not distinguish between family,friends and unknown visitors.

<table>
<thead>
<tr>
<th>Features</th>
<th>Smart Doorbell (Proposed System)</th>
<th>August Cam Bell</th>
<th>Doorboot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snapshot of visitor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSM text</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSM phone call</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>VOiP phone call</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Facial recognition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost price</td>
<td>68 USD</td>
<td>199 USD</td>
<td>164 USD</td>
</tr>
</tbody>
</table>

Table 1:

B. Face Recognition concept: Haar Feature Cascade
Image comparison is a significant process which involves comparing two matrices. The process may get complicated if it involves many features that need to be compared. There are 6000 features involved during comparison while recognizing a given face. Time complexity takes a huge toll thereby shunning the feasibility of the face recognition module.

A cascade classifier, so to speed up the detection process
This brought up the idea of cascade classifiers where these features were divided into 38 classification levels. This is known as Haar Feature Cascade. Sequentially all the features in a particular level are compared. If all the features of a level are matched then the comparison process is handled to next level and henceforth. If suppose the features in the first level do no match, then that level is discarded and the comparison process terminates declaring the given image does not belong to the local image in database. If all the levels complete the comparison process, then the given image belong to sought item.

III. PROPOSED SYSTEM

The following figure explains block level representation of the proposed system. It shows how different modules interact with one another and the entire flow of information in the system.

A. Snapshot of the Visitor

The camera module of Raspberry pi has a capability of taking full HD 1080p photos and is easily programmable

1) Hardware Implementation:

The flex cable is inserted into the connector which is situated between the Ethernet and HDMI ports, with the silver connectors facing the HDMI port. The flex cable should be inserted firmly into the connector. The upper part of the connector is to be pushed in the direction of the HDMI connector, while the flex cable is held in place.

2) Software Implementation:

1) Enabling the pi cam

- Open the raspi-config tool from the Terminal using "sudo raspi-config"
- Enable your camera, then go to Finish and you'll be prompted to reboot.

2) Programming the pi cam:

Libraries for use of pi cam are available in Shell (Linux Command line) and Python. The implementation in this project uses ‘python-picamera’ library. It is a Python interface to the Raspberry Pi camera module. This library is available in the Raspbian archives. Also, SMIME and SMTP libraries of python are used to attach and send the snapshot to the user’s phone through mail.

B. GSM Phone Call and Text notification.

1) Hardware implementation:

GSM is a TDMA based wireless network technology which is robust and widely used. The modem used in the system is GSM SIM900A. Communication takes place by interfacing the Transmitter, Receiver and Ground pins of the GSM modem with the respective GPIO pins of Raspberry pi. The SIM900A is powered by an external 9V source. Also to enable the voice conversation, a speaker through an amplifier and a microphone are interfaced with the GSM modem.

2) Software implementation:

1) Testing the GSM modem using Minicom:

Minicom is a Command Line Interface used as a modem control and a terminal emulation software written for Unix like operating systems. After the initial configuration of minicom, a set of AT commands are used to test the different parameters of GSM modem as given below:

Fig. 2.1.1: Detection process. 

Fig. 3.1.1: Setup of camera module

Fig. 4.1: System design of Doorbell

Given below are the details of implementation for the different modules of the smart doorbell:
2) Executing Call and Text

The ‘Serial’ library of python is used to transfer the required AT commands to the GSM module through a python script. This script is invoked on pressing of the doorbell and based on the user’s preference settings. The set of AT commands to be used in the call script are:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Return</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+CSQ</td>
<td>check signal quality</td>
<td>+CSQ:30,0</td>
<td>30 is the quality of signal, max at 31</td>
</tr>
<tr>
<td>AT+CPIN?</td>
<td>check sim card status</td>
<td>+CPIN:READY</td>
<td>Sim card is found</td>
</tr>
<tr>
<td>AT+COPS?</td>
<td>check card service provider</td>
<td>+COPS:0,0,&quot;CHINAMOBILE&quot; or empty</td>
<td>CHINAMOBILE is the service provider</td>
</tr>
<tr>
<td>AT+CNUM</td>
<td>Check the number of current sim card, not all kinds of card support this function</td>
<td>+CNUM:&quot;&quot;&quot;,15902020353&quot;,129,7,4</td>
<td>phone number 15902020353</td>
</tr>
<tr>
<td>AT+CGSN</td>
<td>Check the module IMEI, worldwide unique</td>
<td>869988012018905</td>
<td>869988012018905</td>
</tr>
<tr>
<td>AT+CGMM</td>
<td>Check the module model type</td>
<td>SIMCOM_SIM900A</td>
<td>SIM900A</td>
</tr>
<tr>
<td>AT+CGMI</td>
<td>Check the module maker</td>
<td>SIMCOM_Ltd</td>
<td>Made by simcom</td>
</tr>
<tr>
<td>AT+ATE1</td>
<td>on/off AT commands return info</td>
<td>send either ATE0 or ATE1</td>
<td>-</td>
</tr>
</tbody>
</table>

ATA
answer the incoming phone call

ATH
hang off current phone call

IV. SYSTEM FLOWCHART
V. FUTURE SCOPE

A significant add on to the system will be the android mobile app which encapsulates all functionalities. The app gives user control over required forms of notifications using preference settings. Moreover, using the potential pi-cam module, live video stream capturing the front of the door can be transmitted to the user on demand. With gradual maturity of raspberry pi security protocols, the proposed system can also be used for night surveillance.

VI. CONCLUSION

The proposed system with its GSM and IOT capabilities solves a important problem in our daily life. An important aspect is that the prototype and setup can be used to implement various related systems such as automatic meter reading wherein the required billing information can be captured and transmitted using the raspberry pi. This application will be time based and can be used for sending notifications to both the user as well as the service provider.

REFERENCES