An Intelligent Door System using Raspberry Pi and Amazon Web Services IoT

S. Nazeem Basha[1], Dr. S.A.K. Jilani[2], Mr.S. Arun[3]

Student (M.Tech in Micro and Nano Electronics), Madanapalle, India[1]
Professor, Department of Electronics &Communication Engineering, MITS, Madanapalle, India[2]
Assistant Professor, Department of Electronics & Communication Engineering, MITS, Madanapalle, India[3]

Abstract: *In this paper, we are demonstrating an i ntelligent door system using Internet of Things, which notifies intrusion by sending out email notification to the owner. It logs all the intrusion d ata into google spreadsheet of owner's google drive account. ADXL345 accelerometer detects the change in motion of the door and raspberry pi to read sensor intrusion data and to communicate to t he Amazon Web Services Internet of Things(AWS IoT) console. Based on the messages from the AWS IoT console, AWS Simple Notification Service(SNS) will send out email notification to the concerned owner based on the AWS IoT console message. Simultaneously all the intrusion logs are stored int o google spreadsheet by OAuth2.0 protocol to access related google Application program inter face (APIs). Obtaining the accelerometer sensor data is done by using python programming langu age and interface the obtained data on IoT. By successfully performing this system, it can be used as a prototype in stengthening door security in ma ny applications such as bank burglary, home invasions, Ram-raiding, office door bre aching and lock picking. The proposed system provides a break through by utilizing the sensor activity on various applications as it is represente d using Amazon Web Services IoT which is an e merging area of research.*

Index terms: *Raspberry Pi, Raspbian OS, Amazon Web Services Internet Of Things, AWS SNS cons ole, OAuth2.0 protocol.*

1. INTRODUCTION

Engineers with business methodologies are the greatest support to our society. The advancements in technologies drive their thoughts and speculates to achieve various goals in fields of science. Arduino has been used as a platform to work for a long time. But with the dispatch of Raspberry pi, a credit card size low-price affordable computer, Arduino is no longer used in application platform. Raspberry pi platform is being used widely from the past few years as it provides easy use support and documentation. It is readily available to all the end users. From simple educational to smart application projects, Raspberry Pi has proved its significance in the development of applications spreading out in various fields. Raspberry Pi equipped with a internet access (Wi-Fi USB dongle or Ethernet cable) is used as a network device.

The ADXL345 is a smart 3-axis accelerometer sensor which is small, thin with high resolution (13=bit) measurement at up to ±16g and runs on ultra low power. Digital output data is available as 16-bit 2's complement and is accessible through either a SPI (3- or 4-wire) or I2c digital interface. It is preferred mostly for all mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 mg/LSB) enables measurement of inclination changes less than 1.0°.

1.1 How to call To Amazon web services Internet Of Things and Google spreadsheet with Python (A Memory/CPU Monitor):

Raspberry pi uses python language instructions to communicate to AWS IoT and google logging web service by OAuth ptotocol. Internet of things allows data sync from devices, sensors, computers. AWS IoT provides an software development kit to easily connect hardware device or mobile application. The AWS IoT Device SDK enables devices to connect, authenciate, and sync messages with IoT using MQTT(MQ Telemetry Transport) standard publish- subscribe protocol. Amazon SNS(simple notification sending) is a fast, formable, fully managed messaging service. It is a cloud-based mobile app notification service to send push notifications, email, and sms messages: or as an enterprise-messaging infrastructure. Google APIs(application interfaces) use the open authorization OAuth 2.0 protocol for authenciation and authorization. Google supports OAuth 2.0 protocol for those for web server, installed and client side application. It can log the intrusion data in the spread sheet and having some security credentials, which maintains real-time updates. Updating spread sheet is done by using gspread

library which is to be installed to open spread sheet using python program.

2. LITERATURE SURVEY

Raspberry pi is interfaced with sensors to obtain related sensor reading data. This device has been widely used in many fields. Reading the data of the sensor's on arduino was studied from arduino based embedded system paper[1]. Intelligent Transport System using visual motion sensor was proposed by M. Soga and K.Yamada[2]. Andrew Burkett has proposed an excellent system to in terface raspberry Pi to a Six-Axis Gyro sensor bas ed on a MPU6050 chip. It also show commands to interface the sensor and install the smbus module w ith some simple Python code to read the data it offers[3]. G.Z. jinn & X.Y.Chen had research on this key technology and its applications for Internet of Things[4]. Feng X and Lawrence proposed a v ery basic system for communicating to internet of things and should be extended to allow other senso rs to be configured with different parameter levels. In my application, I have embedded intrusion data i nto a web server. It allows to make a simple http re quest to the Raspberry Pi and get a reading from the sensor and log data into spread sheet.

3. SYSTEM DESIGN

3.1 Hardware System Design:

3.1.1 Raspberry Pi board:

Raspberry Pi board is a miniaturized fascinated computer having ample processing speed and size not bigger than credit card. Incredible things can be done by using it. Firstly, To work with raspberry pi, we need a list of things to get desired operation and functioning.

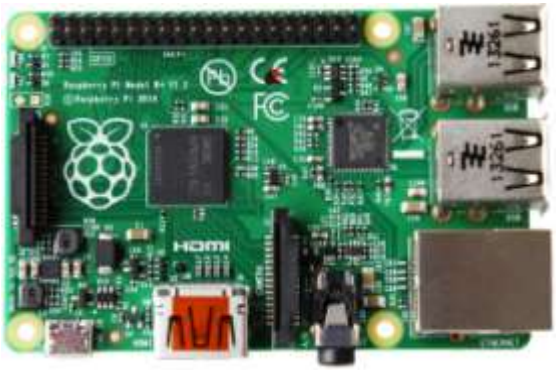

Figure 1: Raspberry Pi computer Model B+

The Model B+ is the most popular updated version of the Pi, with an enhanced functionality. But it uses bit more power to feed the processor. The Model B has received a stealthy update after it was released by adding some more RAM. But the Raspberry Pi Foundation has released third version of the Model B called the B+. Difference exists in the arrangement of components on the pi board. Sd card is sized to Micro sd along with the removal of the video outport. Four usb ports are now available compared to two on model B. All the input and output pins are placed along the sides of the pi to make workspace for project. 40 GPIO pins are now accessible while preserving the same layout as previous version. Same pin configuration is reserved which comes in handy in implementing old projects which were on old pi models. Nearest form factor is achieved as all the connections are along broad edge. Two more clock signals are available along with three extra serial peripheral.

3.1.3 Accelerometer sensor- ADXL 345 :

The ADXL345 is an accelerometer sensor with high resolution(13=bit) measurement at up to ±16g. It is programmed to raspberry pi using I2c interface or SPI interface.

Figure 2: ADXL 345 sensor

Sensor can be interfaced to raspberry pi by using two methods. One by using simple fritzing connection of pins and the other by sunfounder kit.

3. 1. 4 Additional Hardware utilized Compatible to Raspberry Pi:

For the project use of Raspberry Pi is not enough. For input and connectivity some other devices are required.

1. Wifi Adapter
2. SD card
3. Monitor
4. HDMI to VGA converter
5. Mouse and Keyboard

3. 2 Software System Design:

3. 2. 1 Raspbian OS:

Raspbian Jessie version is used in this project. It is based on Debian linux and different versions of os are named from toy story film characters. This Os is fully revised for the raspberry Pi's hardware. Modifications were made

to enhance system processes performance. It runs LXDE (Lightweight X11 Desktop Environment) as the desktop environment. Upgrading to raspbian jessie from rasbian wheezy will add a considerable amount of changes and improvements to desktop user interface.
Pi python programming:

A. GPIO library:
"sudo apt-get install python-rpi. gpio"
B. I2C library :
"sudo apt-get install i2c-tools"

The figure 4 shows the installation of I2C tools

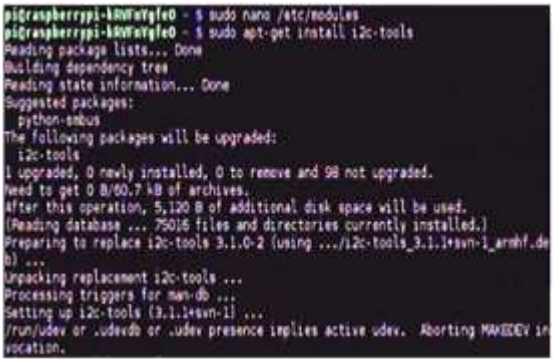

Figure 3: I2C tools installed

C. Installation of python-smbus module:

"sudo apt-get install python-smbus"

Figure 4: Python smbus installed

D. Connecting ADXL345 sensor: After connecting accelerometer, run i2cdetect command to check the connection.

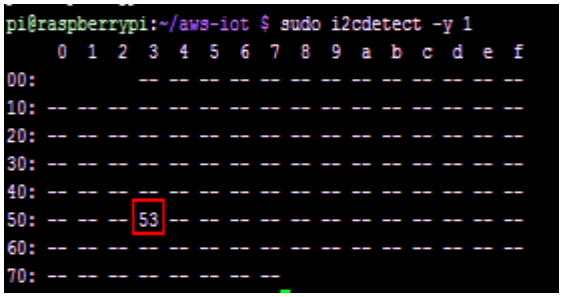

Figure 5: After interfacing with ADXL345 sensor
If the sensor is connected correctly, it is detected at the 53 port of the i2c bus as shown in above figure

3.2.2 AWS IoT:

AWS IoT permits guarded, bi-directional communication between IoT devices(such as sensors, actuators, embedded devices, or smart a ppliances) and the AWS cloud over MQTT. This platform facilitate required connections between people and things. Real time data collection, analysis and processing of the position information, data visualization transmission of messages using SNS module are the main features of AWS IoT. It helps in easy transfer data from embedded devices such as Arduino, Raspberry Pi.

IV. PROPOSED SYSTEM

The proposed system is Detecting intrusion of a door and sending the sensor information utilizing AWS IoT and Raspberry Pi. The objective is to design and implement the system to notify the owner when there is an intrusion and logging all the data into google spread sheet for further inspection. In this system, ADXL 345 acclerometer sensor is used to sense any change in the motion of the door and raspberry pi to communicate to the AWS Iot console. When there is an intrusion at the door, IoT console invokes SNS module to send notification to the owner. Intrusion data is logged simultaneously into the service account google drive in form of spread sheet.

Block diagram:

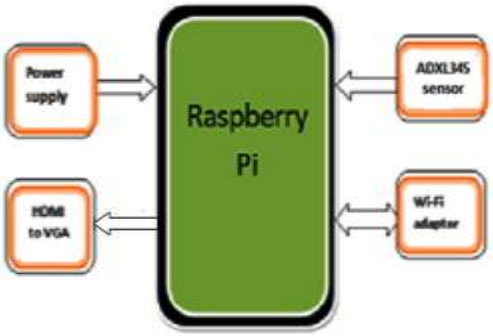

Figure 6: Block Diagram of the proposed system

The proposed work is done in two stages, which are in hardware implementation and software implementation as we discussed earlier.

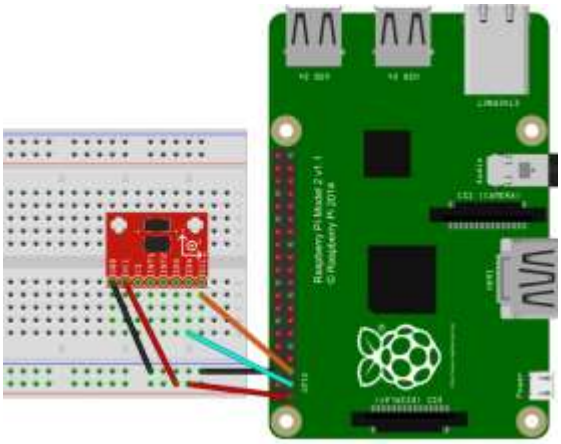

Figure 7: sensor interface to raspberry pi

Flow chart of proposed system:

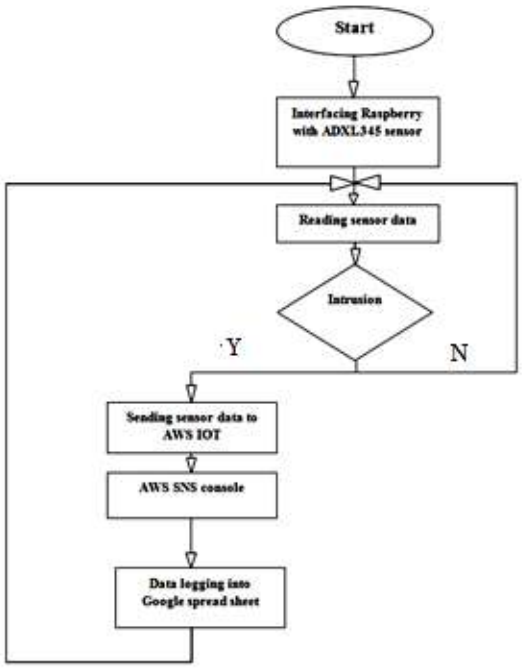

Figure 8: Flow chart of proposed system

Firstly, we have to register raspberry pi device on AWS IoT and download certificate so that to enable communication with the IoT cloud. Certificate should be placed in the parent directory of the program using python. It contains secured credentials to connect to IoT console. Raspberry Pi should have a resource to be created in cloud. Device thing is to be created next by the same name of raspberry pi. No need of additional attributes for creating this thing.

Using python programming, certificates can be generated. Alternatively selecting sdk as Node Js, unique certificates for pi device can be created.

Figure 9: AWS IoT console

Winscp program is used to transfer necessary certificates and libraries to the pi memory. Communication is done by using ip address of the raspberry pi. This program provides bi-directional transfer of files.

In addition to IoT certificate, AWS requires license from Symantec. It is acquired by python programming and results a public private certification authority key file.

For raspberry pi to create or edit a spread sheet, it should get a authentication from Google drive API scope. OAuth 2.0 is used to request access to drive api. A service account is created under a main google mail and it will be given access to spreadsheet. In order to access APIs, related credentials are required like an API key, Service account or OAuth 2.0 client id. In this system, a service account is created having login information such as client id and private key. Required oauth2client libraries are installed for python.

Door is equipped with accelerometer sensor so that X-axis is always facing top. When door is closed, readings of the sensor are negative in Z plane. If there is an intrusion, Readings of Z-axis become zero or positive. If intrusion happens, it will publish a string "Intrusion detected" to the SNS console and email is sent instantaneously and spread sheet is updated.

V. RESULTS

Results will be seen after running the code. If intrusion is detected, owner will get a push

email notification instantly and intrusion data is log ged into spreadsheet simultaneously. Intrusion detection string is published on IoT console and output console of python.

If MQTT is running , Intrusion detected string is printed on IoT console as shown below.

Figure 10: AWS IoT console intrusion message

Email notification should be enabled on smart phone so as to receive notification instantaneously.

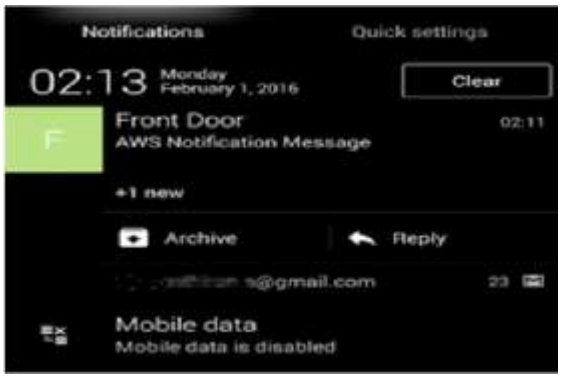

Figure 11: Email push notification on mobile

If email is opened in a browser, we can get an email notification in web browser.

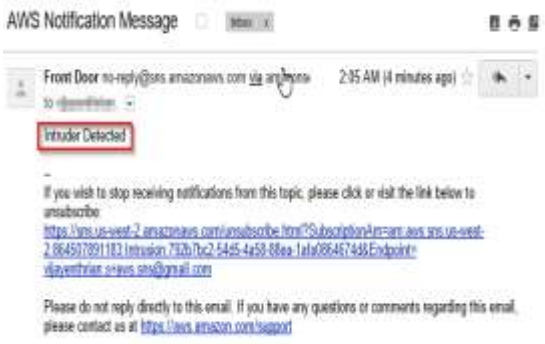

Figure 12: Email in the Browser

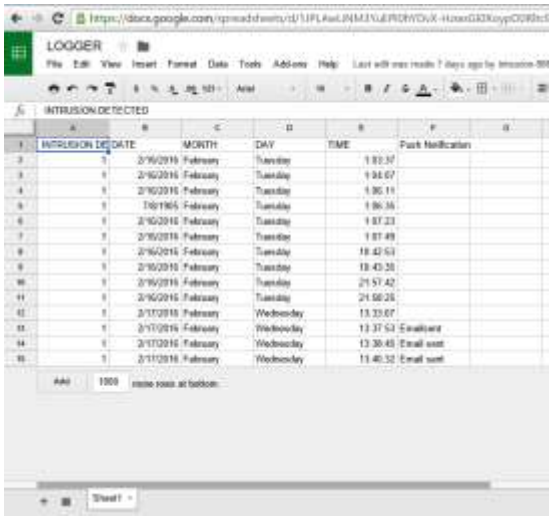

Figure 13: Google Spreadsheet Data logging

Data logged into spread sheet is helpful in analyzing the intrusion and to act accordingly. The data obtained can be see globally. This system can be upgraded to various applications like sensitive alarm systems, Automation of homes and offices amd bank security applications.

VI. CONCLUSION AND FUTURE USE

Proposed system is cheap and components are readily available. It is portable and easily upgradable. Adding with different types of sensors along with the proposed system, we can make many smart applications like home automation, Eagle eye monitoring, Bank door security. With the addition of smart things compatible lock system, we can lock or unlock door from anywhere using smart phone. Interfacing with servo motor can be useful further to trigger the door to automatically unlock or lock as someone approaches. Smart things compatible alarm system is future improvement of proposed system which notifies intrusion by a loud alarm. This project is a prototype for various security applications based on raspberry pi and internet of things.

ACKNOWLEDGEMENT

I extend my earnest on account of professor **Dr.S.A.K. Jilani**, Assistant professor **Mr.S. Arun**, Department of ECE. Furthermore my sincere thanks to **Dr.A.R.REDDY**, Head of the Department of ECE for their backing to complete this exploration work effectively.

REFERENCES

1. " Embedded System Based Air Pollution Detection in Vehicles " S. Arun, V. Siva Krishna, J.L Mazher Iqbal in International Journal of Emerging Technologies in Computational and Applied Sciences .
2. Yamada, K. and M. Soga, A compact integrated visual motion sensor for ITS applications. Intelligent Transportation Systems, IEEE Transactions on, 2003.
3. Azrina Abd Aziz, Y. Ahmet S¸ekercioglu, Paul Fitzpatrick, and Milosh Ivanovich, "A Survey on Distributed Topology C ontrolTechniques for Extending the Lifetime of Battery Powered Wireless Sensor Networks", IEEE communications surveys & tutorials, VOL. 15, NO. 1, FIRST QUARTER 2013
4. Sandborn, P.A.M. and P. Abshire. 2D motion sensor with p rogrammable feature extraction. in Circuits and Systems (ISCA S), 2013 IEEE International Symposium on. 2013. [3] Kamnik, R., S. Stegel, and M. Munih. Design and Calibration of Three Axial Inertial Motion Sensor. in Power Electronics and Motion Control Conference,2006. EPE-PEMC 2006. 12thInternational. 2006.
http: //invensense.com/mems/gyro/documents/RM-MPU-6000A.pdf.
5.Kosba,Ahmed E., and Moustafa Youssef. "RASID demo: A robust WLAN device-free passive motion detection system. "
6. Dipti Javale, Bharti Dixit ,Pankaj Javale, "Performance evaluation of wireless transmission using embedded system", IEEE paper, November 26 ,2009.
7. Flavia C. Delicato, Paulo F. Pires, Luci Pirmez, Thais Bat ista"Wireless Sensor Networks as a Service", 2010 17th IEEE International Conference and Workshops on Engineering of Co mputer-Based systems
8. X.Y. Chen & Z. G. Jin, "Research on key technlogy and ap plications for Internet of Things," Physics Procedia, vol. 33, pp. 561-566, 2012
9. Feng, X. & Laurence, T.Y.. 2012. Internet of Things. Int ernet of Things (2014), retrieved from Microsoft[ONLINE]

AUTHORS DESCRIPTION

1. S. Nazeem Basha is pursuing his M.Tech in the stream of Micro & Nano electronics from Madanapalle Institute of Technology and Sciences, Madanapalle. He completed his B.Tech in the stream of Electronics and communication, from Madanapalle Institute of Technology and Sciences, Madanapalle. His areas of interest are embedded systems, IC fabrication, and Micro & Nano electronics

2. Dr. S A K Jilani is working as the Professor and project coordinator in the department of ECE, Madanapalle Institute of Technology and Sciences, Madanapalle. He has the teaching experience of over twelve years. He also worked as an R&D Professi- onal earlier in Electronics Industry. He obtained his PhD In the year 2002 and also published more than 35 papers in different national and international Journals. He has also guided more than 50 M.Tech, M.Sc, MCA, B.Tech Projects. His areas of interest are Artificial Intelligence, Computer Visions, Digital Signal Processing and Embedded Systems.

3. Mr. S. Arun received B.E from A.V.C college of Engg, Anna University & M.Tech from Amrita school of Engg. Amrita VishwaVidyapeetham University. At present He is with Madanapalle Institute of Technology and Sciences, Angallu, Madanapalle, working as a Assistant Professor in Dept. Of ECE,. He guided more than 20 B.Tech projects. He presented many research papers in National & International conference.