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A Wireless Framework for Automotive Monitoring Systems

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Abstract

Background/Objectives: Sensors implementation in automobiles has become a prime factor in the growth of the automobile industry. The quality of an Automobile is determined by the number of sensors integrated and also the sensitivity of the sensors to deliver the nominal conditions of the surroundings of the automobile. **Methods/Statistical Analysis**: The impact of sensors in today's automobile industry varies in multiple numbers of applications starting from the control of the automobile till the safety of the passengers in the automobile. Tilt sensor and Accelerometer function are utilized to analyze the car condition during a crash incident, where the change in tilt condition of the car or the accelerometer value can trigger a camera to capture the image and transmit the image to an authority of preference through mail client. **Findings:** The impact of sensors in today's automobile industry varies in multiple numbers of applications starting from the control of the automobile till the safety of the passengers in the automobile. These results are obtained by the integration of numerous sensors and the combined data values obtained from them for calculating the complexity of the situation. The project involves the combination of sensor value details and to be able to monitor the values from a remote location by feeding them into a platform which utilizes the cloud storage. A web server is also designed where the sensor values are saved in the form of log files with time stamp for future reference. **Conclusion/Improvements**: The overall system is employed with the help of a Beagle Bone Black microcontroller which is an effective replacement of a computer performing all the desired functions as such as a computer does towards the understanding of the system development.

Keywords: Beagle Bone Black, Blackbox, IoT, Thingspeak

1. Introduction

Automobile industry has been facing a constant increase in the utilization of electronics for the purpose of increasing the energy and efficiency of a product. This is achieved by the smart sensor system provided by the automobile industry for the development of a safe and secure travel system.

A system where physical items or "things" installed with gadgets and sensors were programmed to speak to the internet with more power of administration and monitoring capabilities within a network and other joined devices is nothing but Internet of Things (IOT). Everything is extremely identifiable through the installed cloud framework and has the capability to interoperate within the current internet consortium.

IoT is needed to gain access to the high level network of devices, frameworks and administrations that goes past the machine-to-machine interchanges (M2M) and spreads a miscellany of conventions, applications and areas. Internet of Things has been actually implemented in various management networks like Home Automation, Healthcare etc., where different parameters can be monitored regularly in real time without any delay. In the same way IoT provides lots of innovations in Automotive Monitoring systems.

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In Automotive industry IoT plays a very crucial role by monitoring the different conditions of the automobile and updating the same to the preferred locations on internet. IoT has opened a new path towards the evolution in technology and internet.

Massive rise in Internet usage and variations in the networking technologies has made systems to communicate with a very higher data rates. IoT allows the machine to communicate with such a large number devices with human interaction. Thus a unique system of omnipresence exists within the network of communication. The development is not just in the monitoring part of the network but also in the way it stores all the required information from different devices for future review.

This gathered information from different sensors will be passed to the cloud architecture by controller which will be to transmit values given by the sensors for monitoring.

Hae-Rim Yang, Chan-Se Jeong, Hac-Sun Kim, Soon-Yong Yang constructed a system to monitor vehicle preferences by using the values gathered from acceleration pedal, brake pedal, speed and RPM measured. The main purpose was to construct a black box with the help of embedded system[1].

In[2] proposed a system to locate any near approaching vehicle thus warning the driver if any collision sequence is identified. An algorithm was constructed to determine the course of action and to identify the collision prior to its occurrence. In[3] designed a module system to avoid collision by the data inputs from the sensors. A wireless sensing capability was achieved which was a valuable alternative to predict collision and needs to avoid it. In[4] worked on the enhancement of the safety features of a vehicle. They provided a robust safety feature which does not depend on a single sensor module but is a combination of multiple sensors thus reducing the chances of malfunction of the system. By combining more than one data information a precise assessment of the environment around a vehicle was able to be determined. In[5] developed a optical sensor for the estimation of the tilt angle of a vehicle. The designed system was a low cost and reliable device with exceptional throughput. In[6] developed a system for object verification from a camera recognizing the images through signal and image processing techniques. In[7] proposed the idea of the utilization of the automobile as a sensor itself. They gave forth the idea of analyzing and gathering information about the surrounding with the sensors embedded on a vehicle allowing the vehicle itself to act as a sensor. Various in vehicle sensors were discussed which were used for the purpose of distance measurement, to monitor the surrounding at night and for speed calculation. Inter and Intra in vehicle communication technologies were also discussed. In[8] proposed collision warning system by tracing the movement of the vehicle in the front. The detection is categorized as night and day, where the detection depends on the tail light of the vehicle ahead during night. This was a effective embedded system environment yielding desired levels of success for collision data availability. In[9] utilized the working of a 3 axis accelerometer sensor to design a working model for fall monitoring of a human. Using hidden markov model a algorithm was developed which predicts the fall scenario before the action takes place making way for preventing such scenarios from occurring. In[10] designed a prototype framework for cloud storage and have discussed the benefits of the internet of things in the field of embedded systems. Hindrances like large data storage and management services, dynamic variation of incoming data were overcome by the proposed framework development[10].

In[11] proposed internet of things architecture combining ubiquitous ID and constrained application protocol which requires minimal efforts for the devices with constraints on utilization of resources to be provided to them. This Application peripheral interface acts as a software framework for the embedded device nodes. Thus an improved framework was proposed without much effort in the altering of the programming.

2. System Implementation

The system in Figure 1 consists of a novel approach towards the development of a sensitive network for a better knowledge of the present scenario of the automobile.

The working methodology involves three phases: the sensors are integrated and the physical attributes are converted into electronic signals and processed to a beagle bone black controller with the help of which, it will be transmitted and fed into a cloud storage medium for monitoring. The real time sensor data will be hosted in a web server for future reference. Final phase is that depending on the tilt sensor data, he webcam will be initialized for taking a snap shot and the images will be sent to the authenticated person via Mail client.

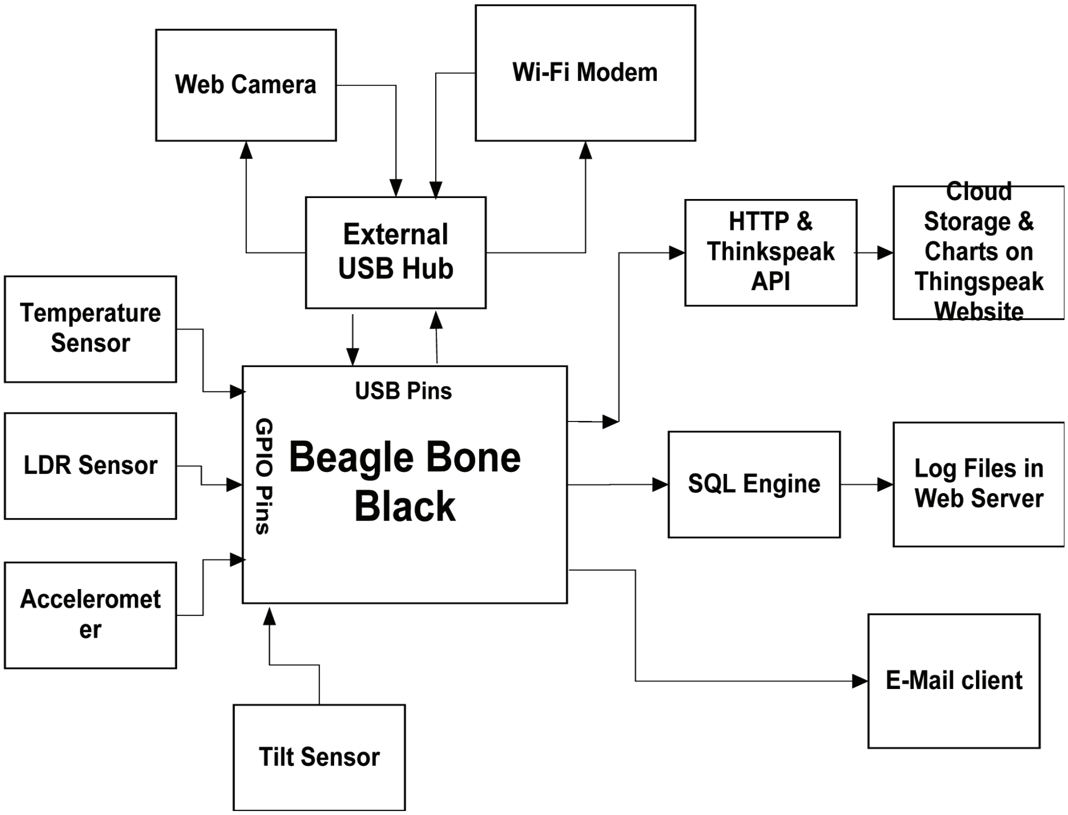

Figure 1. Block diagram.

2.1 Real Time Sensor Integration with Cloud

The sensors interfaced with Beagle bone Black will be collecting the data continuously. Beagle bone black will be connected to a Wi-Fi modem, which favors in updating the values obtained from the sensors in the cloud network storage. The cloud platform storage utilized for this purpose is Thingspeak. An online cloud platform which generates an API key and a feed ID.

This Application Programming Interface key is used in the python script to send the data to the cloud server.

Any number of keys can be allocated to a particular function. Each key provides permission to access the resources and also to control data availability to public or private. HTTP requests are made for the communication between the Beagle Bone Black and the Thingspeak platform. The feed of the data also includes a location preference and allows for 8 fields of data.

The values of the sensors will be measured and given to analog input pins of the Beagle Bone Black. The Beagle Bone Black consists of a USB port which is expanded by using a USB hub to connect two or more devices. For transmitting the data over internet, a USB Wi-Fi modem is connected to the Beagle bone black using a USB hub and it is configured to receive the open Wi-Fi available in the range.

Thingspeak is a cloud platform where the sensor values can be updated in real time and also chart view is available. Thingspeak generates an API key and also a Feed ID key for each channel, which we use in our python code to update the sensor values in Thingspeak. Thingspeak platform displays values getting updated in the server in real time and a graphical view will be used to display the variation in sensor values at different time.

The Application Peripheral Interface key generated by the Thingspeak effectively points the http request to POST the value taken as output from the sensor interface devices. So it will post the data taken from the sensor to the particular fields on the cloud.

2.2 Web Server for Data Storage

The values taken from the sensor as shown in Figure 2 will be stored as log files on the web server. There is a SQL package available for the Debian OS which was ported on

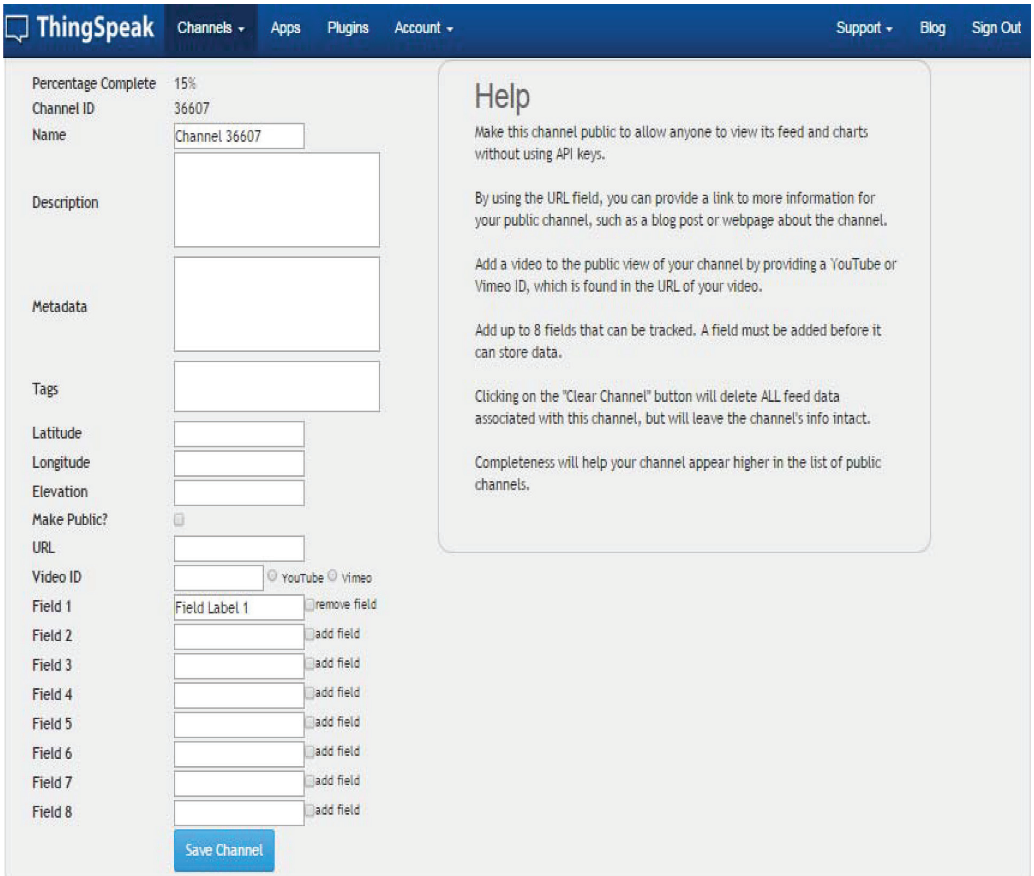

Figure 2. Channel data.

the Beagle Bone Black. So the files will be available within the network for download. SQL engine is utilized for the purpose of hosting the data and storing web server.

The database engine is utilized for its fast and efficient way to store and stack up the data obtained from the sensors.

2.3 Crash Recognition and Alert System

A tilt sensor as well as an accelerometer will be constantly updating the position of the car. The tilt sensor is composed of a round movable metal ball which is placed on a conductive plate. The plate has a small gap and thus when the power is given for the sensor, the ball will close the circuit and will give some voltage. During the tilted condition, the ball moves away from its position causing an open circuit. The accelerometer outputs the position of the automobile in relative to all the three axes. In the automobile, when a tilt is detected or when there is a sudden deceleration, then we can assume that automobile met with an accident. So as soon as there is variation in the voltage from the tilt sensor or accelerometer, the system will trigger the camera which enables it to capture images and transmit it to the authorized person by utilizing an E-Mail client. If no crash is experienced, the sensors other than tilt sensor are constantly updating the data values into the server and the cloud network simultaneously.

3. Results

The obtained results and outputs are displayed in the following figures:

The complete hardware set up of the system is shown in the Figure 3.

The configuration of Wi-Fi modem and allocating the beagle bone an IP address is shown in the Figure 4.

Figure 5 shows that the values from the sensors are getting updated to Thingspeak in real time. Thingspeak will show the chart of acquired data values vs time. These values will be updated continuously as long as internet connection is not disconnected from the Beagle Bone Black.

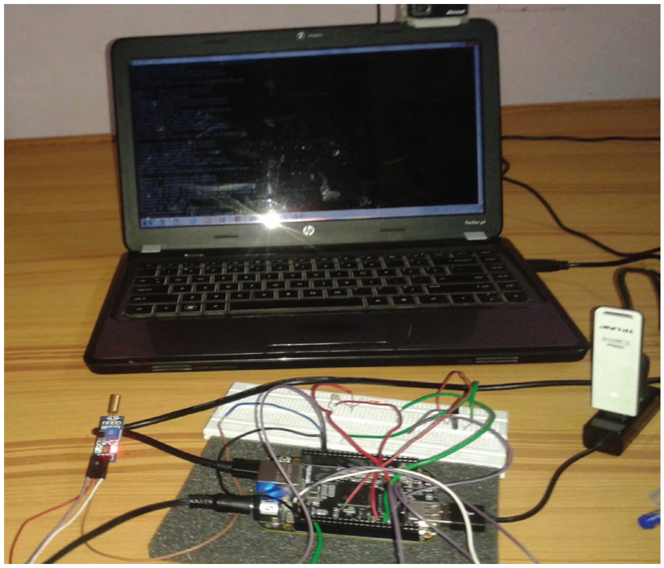

Figure 3. Complete hardware setup of the proposed system.

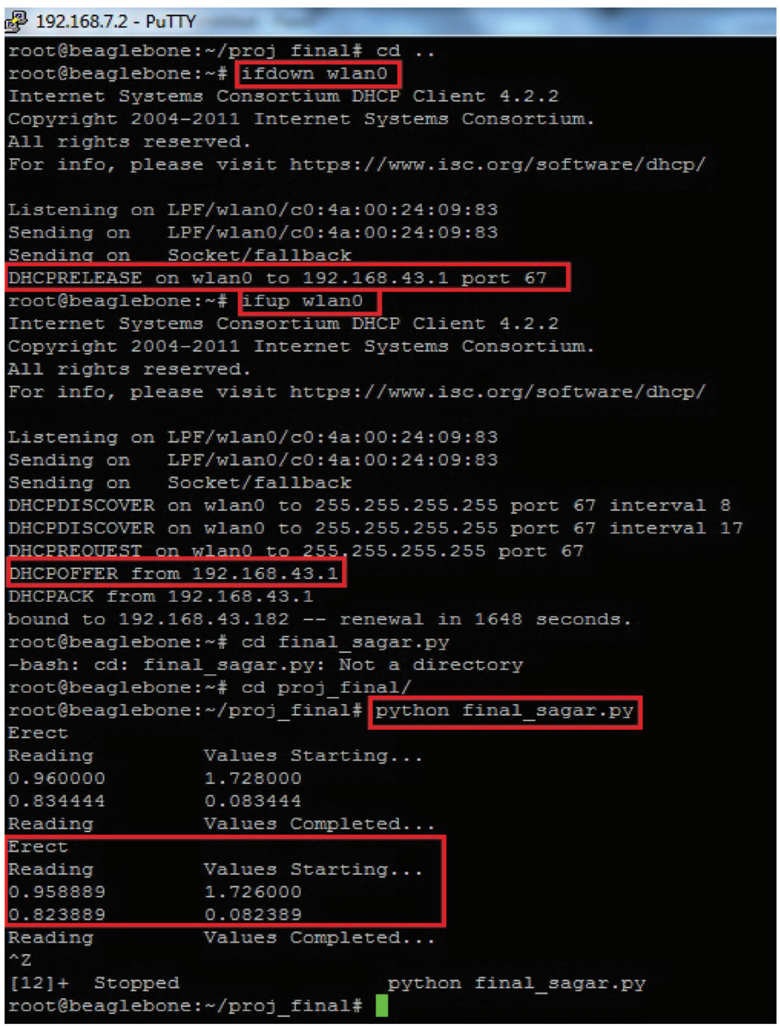

Figure 4. Values generated in Beagle bone black.

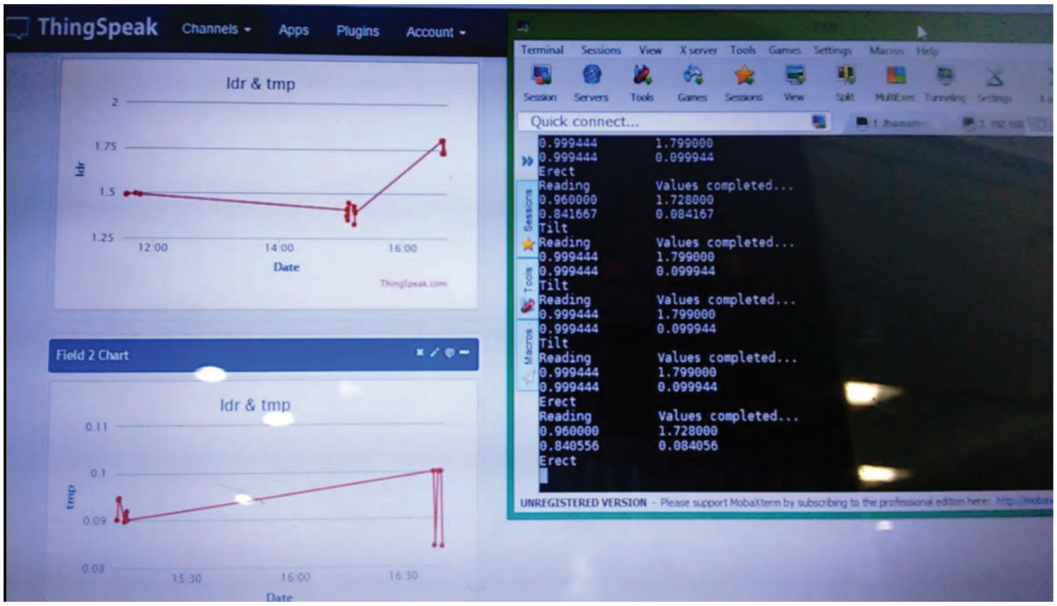

Figure 5. Values updated to the Cloud Platform.

Figure 6. Sensor values stored as log files in web server.

Figure 6 shows the web server of the beagle bone black with the updated log files for temperature and the LDR values.

Figure 7 and Figure 8 shows that the Automobile crash is detected in the Beagle Bone Black and the web camera is getting iniatialized for capturing the image.

Figure 9 shows that the image captured by the web camera was sent to the authorized person via E-Mail Client.

4. Conclusion

The efficiency of an automobile system depends on the capability and sensitive of the sensor devices installed in the system to provide effective measures for the development and integration of a ubiquitous operating environment. The proposed system utilizes the temperature and humidity sensors to determine the conditions of an automobile towards the environmental changes and

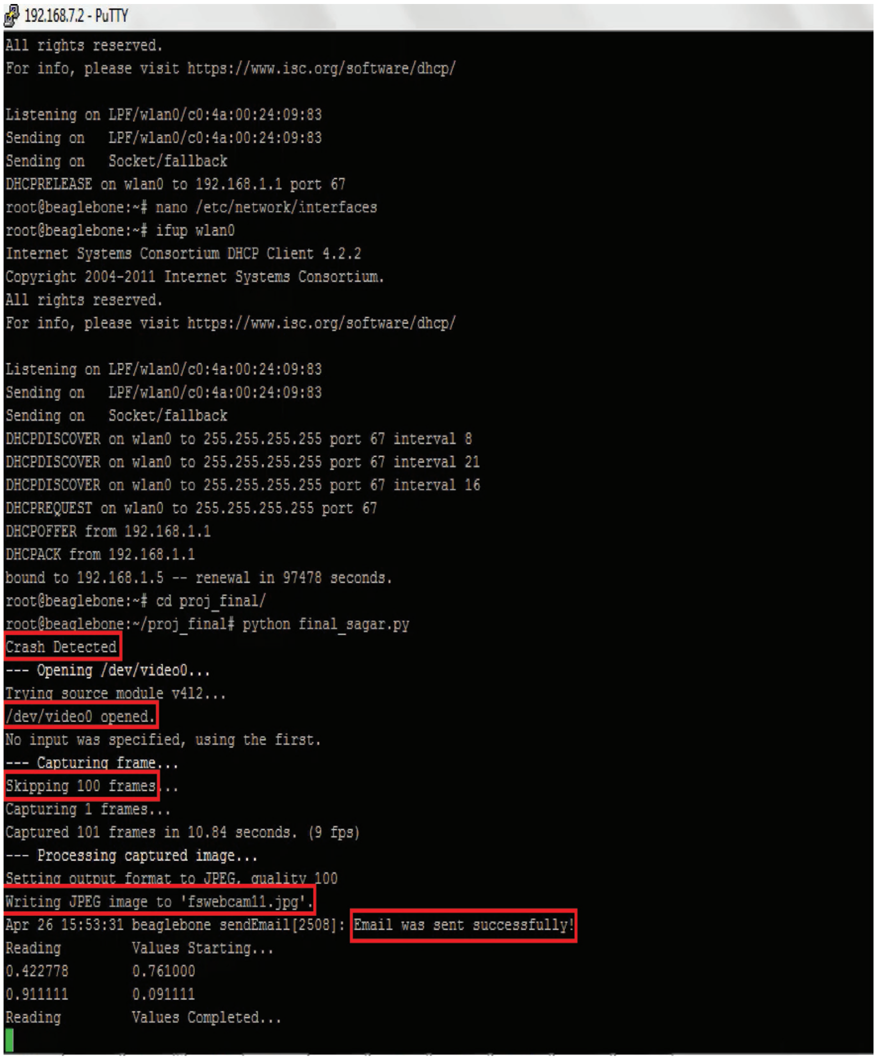

Figure 7. BeagleBone black shows that the crash detected and web camera initialized.

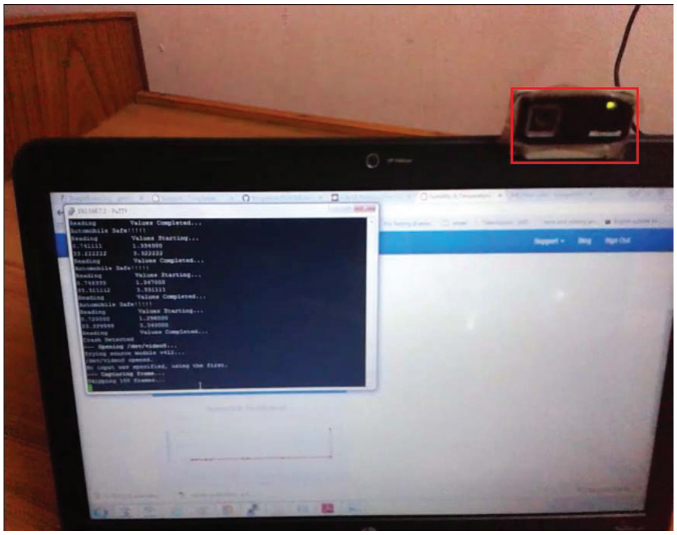

Figure 8. BeagleBone black shows that the crash detected and web camera started to capture Image.

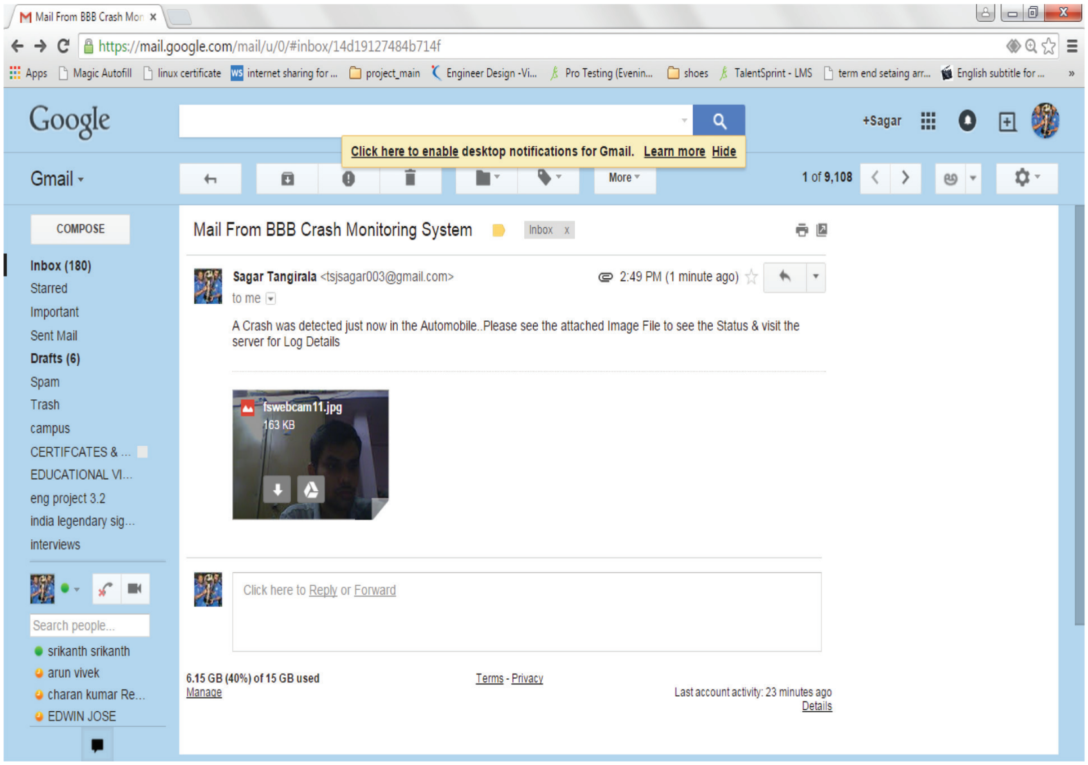

Figure 9. Mail received at the authorized person saying that the a crash was detected in automobile.

also updates those values in a cloud and web server is observed. This allows the monitoring of the data stored on the server from any location where internet service is provided. A sensor to identify a tilt of an automobile during a crash has been designed to alert the respective concerned authorities via E-Mail Client. This system can take the picture from the web cam as soon as a crash is detected from tilt sensor. This overall system provides the monitoring and safety of a passenger travelling in an automobile and also provides a feature to store the information of the automobile over a server which can be accessed by the automobile manufacturer as well as the automobile owner. The future work includes the integration of high number of sensors towards the development of a monitory and safe network system for an efficient automobile system.

Finally the system can act as Black Box for Automobile as it will capture the crash image and will send them to the authorized person via E-Mail as soon as a crash is detected.

5. References

1. Yang H-R, Jeong C-S, Kim H-S, Yang S-Y. A study on overall vehicle monitoring system for black box using lab VIEW. 11th International Conference on Control, Automation and Systems; KINTEX , Gyeonggi-do, Korea. 2011 Oct 26-29. p. 1217–20.
2. Dabbour E, Easa S. Proposed collision warning system for right-turning vehicles at two-way stop-controlled rural intersections. Elsevier, Transportation Research Part C. 2014 May; 42:121–31.
3. Hisaka S, Kamijo S. On-board wireless sensor for collision avoidance: vehicle and pedestrian detection at intersection. 14th International IEEE Conference on Intelligent Transportation Systems; Washington, DC. 2011 Oct 5-7. p. 198–205.
4. Bellino M, de Meneses YL, Kolski S, Jacot J. Calibration of an embedded camera for driver-assistant systems. Proceedings of the 8th International IEEE Conference on Intelligent Transportation Systems; Vienna, Austria. 2005 Sep13-15. p. 354–9.

5. Norgia M, Boniolo I, Tanelli M, Savaresi SM, Svelto C. Optical sensors for real-time measurement of motorcycle tilt angle. IEEE Transactions on Instrumentation and Measurement. 2009 May; 58(5):1640–9.
6. Srovnal V Jr, Machcek Z, Hercik R, Slaby R, Srovnal V. Interlligent car control and recognition embedded system. IEEE International Multiconference on Computer science and technology Wisla. 2010 Oct 18-20. p. 831–6.
7. Abdelhamida S, Hassaneina HS, Takaharab G. Vehicle as a mobile sensor. The 9th International Conference on Future Networks and Communications (FNC-2014). 2014; 34:286–95.
8. Fang C-Y, Liang J-H, Lo C-S, Chen S-W. A real-time visual-based front-mounted vehicle collision warning system. Singapore: IEEE; 2013 Apr 16-19. p. 1–8.
9. Tong L, Song Q, Ge Y, Liu M. HMM-based human fall detection and prediction method using tri-axial accelerometer. IEEE Sensors Journal. 2013 May; 13(5):1849–56.
10. Jiang L, Xu LD, Cai H, Jiang Z, Bu F, Xu B. An loT, oriented data storage framework in cloud computing platform. IEEE Transactions on Industrial Informatics. 2014 May; 10(2):1443–51.
11. Yashiro T, Kobayashi S, Koshizuka N, Sakamura K. An internet of things (IoT) architecture for embedded appliances. IEEER10- HTC2013; Sendai, Japan. 2013 Aug 26-29. p. 314–9.