International Journal of Engineering Research ISSN:2319-6890)(online),2347-5013(print)
Volume No.5, Issue No.7, pp : 594-598 1 July 2016

Development of Embedded Based System to Monitor Elephant Intrusion in Forest Border Areas Using Internet of Things

R.Maheswari
Department of Electronics and Communication Engineering, Panimalar Engg. College, Chennai, India
maheswari.kaja@gmail.com

Abstract: The new era of computing technology is emerging as it will encompass every aspects of our lives with amazing potentials and it can be termed as Internet of Things (IOT). The IOT generally comprised of smart machines interacting and interactive with other machines, objects, environments and infrastructures. In embedded computing system each thing is uniquely identifiable but it is able to be interoperable within the existing internet infrastructure in IOT. As a result, massive volumes of data are being created, and that data is being processed into useful actions that can "command and control" things to make our living much comfortable and safer—and to ease our impact on the environment. In this paper we have proposed a elephant intrusion monitoring system using IOT. The various drawbacks in already existing system using embedded systems can be overcome as we have cloud based services, low cost and advanced miniaturization in packaging technology. Here we are developing a prototype model for real time interaction of elephant intrusion in forest border areas that allows a persistent monitoring by making use of an On board computer and cloud services.

Keywords: IoT (Internet of Things), Raspberry Pi, Geophone, Camera, API (Application Programmable Interface)

1. INTRODUCTION AND MOTIVATION

Human-elephant conflict is intensely on the rise and has become one of the major issues in the fight to save Asia's endangered elephants. Since the HEC is pretense a major challenge to the conservation of Asian elephant, resolving human–elephant clash is the major concern among the conservation community. The elephant is one of the most conflict-prone wildlife species in India, affecting large-scale damage to crops and human lives. Each year, nearly 400 people and 100 elephants are killed in clash related instances in India, and nearly 500,000 families are affected by crop damage. In India, Human-elephant conflict (HEC) is perceived across the country in a variety of forms. The human-elephant conflict includes crop mutilation, human dead, house and other organization damage by elephants and elephant mortality by human. The effort of elephants in Coimbatore Forest Division is mostly controlled to foothills due to escarpment of steep slope on the west and human residences on the east. Therefore human-elephant conflict is higher level compared to other largely populated elephant habitats in South India. This study explores the correlation of reported HEC incidents exclusive 58 villages between 80km from the border of Kallar to walayar, Coimbatore, Tamil Nadu, India. Habitat loss and disintegration is the major threat to the modern survival of Asian elephants in this region. Since Coimbatore Forest Division segments the eastern boundary at the length of about 350 km with human residences and farm lands, the villages neighboring to the reserve forest boundary are highly liable to elephant devastation [9]. Earlier elephants used to visit only forest marginal villages, lucky by standing crops. Nevertheless, elephants are coming frequently into the human residence and crop fields located even more than five kilometers from forest limit. The elephant activities in this division are typically controlled to very narrow paths of the slopes of the large mountains naturally near the human residences. However, destruction is higher when compared to other largely populated elephant surroundings. Like humans, elephants do suffer due to the adverse relations caused on them through injury and killing. More than a few kinds of tackle and strategies are being used for such resolutions.

In our proposed system, the main aim of our work is to alert the people in and around the forest border areas and to prevent their lives. Here, we are developing a prototype model for a real time interaction of elephant intrusion in forest border areas by making use of Internet of Things (IoT). New hardware platforms make embedded systems in IoT applications easier to engineer than ever before. Once you have preferred the hardware platform, however, you still must improve the application software, and that is where further decisions must be made. Not so very long ago, your superior of programming language was smart much uttered by your choice of hardware platform. More new platforms that are created on open source standards and able to maintain multiple languages make more flexibility. One of the key culture platforms for IoT is the Raspberry Pi. The Raspberry Pi is a sequence of credit card–sized single-board computers established in United Kingdom by the Raspberry Pi Foundation with the purpose of promoting the coaching of basic computer science in schools and developing countries. The Raspberry Pi is a widespread platform because it offers a total Linux server in a little platform for a very low cost.The Raspberry Pi 2 has all the modules you need to set a task into the cloud. Just we have to enhance a power supply (a 2 amp micro-USB supply is plenty), link it to the respite of your project, write the code to be conveyed to the outside world via the included Web server, and we will be in the cloud.

Fig1 Elephant Migration

1.1 INTERNET OF THINGS (IoT)

The next trend in the era of computing will be outside the domain of the traditional desktop. In the Internet of Things paradigm (IoT), everything of value will be on the network in one form or another. Radio frequency Identification (RFID) technologies will give growth to this new standard, in which information and communication are imperceptibly embedded in the situation around us. Huge amounts of data will mingle in order to make smart and proactive environments that will considerably enhance both the work and ease experiences of people. Smart interacting objects that adjust to the current situation without any human contribution will become the next logical step to people previously connected anytime and anywhere. With the growing presence of WiFi and 3G wireless Internet access, the growth toward universal information and communication networks is already marked currently. However, for the Internet of Things idea to successfully begin, the computing condition essential to go past traditional mobile computing scenarios that use smartphones and portables. For technology to fade from the consciousness of the user, the Internet of Things demands: (1) a mutual understanding of the circumstances of its users and their appliances, (2) software architectures and pervasive statement networks to process and deliver the contextual information to where it is related, and (3) the computational objects in the Internet of Things that aim for self-directed and smart behavior. With these three foremost grounds in place, clever connectivity and context-aware computation via anything, anywhere, and anytime can be proficient.

In brief, the Internet of Things is a worldwide network of computer, sensors and actuators linked through Internet protocols. The TCP/IP protocol is the vital Internet protocol for such communication developments. It allows the transfer of byte streams between two computers in each direction. The most substantial standard protocol by far is the Hypertext Transfer Protocol (HTTP). HTTP defines how a client interrelates with a server, by directing request messages and receiving response messages over TCP/IP, Web browsers are the most popular HTTP clients, but you can effortlessly mark your own clients—and your own servers.

2. PROPOSED WORK

In this paper we are considering the problem of detecting elephants in forest border areas using IoT (Internet of Things).The main aim of the work is to alert the peoples in and around the forest areas and to prevent their life. Here we are enabling the sensing and actuating technologies using raspberry Pi. The obtained data from the Vibration sensor is send serially to Raspberry pi via Arduino. Thus in our existing work we are enabling Geophone (for sensing vibration) and Webcamera (for capturing photos of Elephants) to have effective monitoring and to reduce false alarm. Here Cloud Computing paves ways for effective utilization of shared resources.As infrastructure is provided by a third-party and accessed via the Internet, users can connect from anywhere. The block diagram of our work is given below and it has two sections namely transmitter and receiver section.

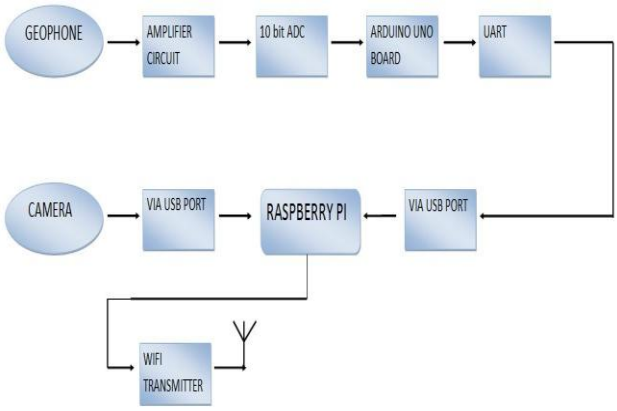


Fig 2.1 Block Diagram of Transmitter Section

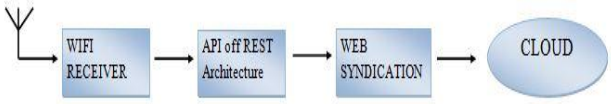


Fig 2.2 Block Diagram of Receiver Section

As given in the transmitter section the sensing parameters are connected to raspberry pi and the obtained data is transferred to the receiver section via Wifi module. Here the vibration signals are obtained as soon as there is a stampede occurring in the buried geophone. As we have already analyzed the vibration signals obtained from geophones for various weights of elephants, we could easily fix the threshold of values in which we can capture the image of the elephant at that level. Thus the obtained voltage value of the corresponding vibration signal is transferred to raspberry pi via the serial port from arduino UNO board. The usage of webcam comes to play as soon as the threshold value getting reached and these details are uploaded in cloud. Thus we have clear idea of detecting elephants and give a alert to the appropriate authorized officials to take care of it. Briefly our work comprises of three phases and they are given as follows:

- Sensing
- Embedded Processing
- Communication

The above given phases of work are explained as follows:

2.1 SENSING PHASE

In Sensing phase our main aim is to design a amplifier circuit for geophone. We have designed the amplifier circuit for obtaining the corresponding voltage values by using the data obtained from previous work. Thus the amplifier circuit is designed by taking maximum voltage as 3.1mv and amplifier gain as 1,600.The amplified vibration signals is sent to the embedded processing phase in the analog form of the corresponding voltage values .The designed amplifier circuit is given as follows:

2.1.1 GEOPHONE

The buried geophone detects seismic activity at the detector location and generates an electrical signal that is scrutinized by the processor to normalize if a specified type of intrusion has occurred. With a single seismic sensor (SP-500), operators can monitor a small area or trail. With multiple sensors (SP-500P) linked in a string, operators can monitor large open areas or perimeters. Intrusion recognition range depends on numerous variables, such as: type of terrain, processor sensitivity setting, number/type of intruders, etc...

Fig 2.3 Geophone buried in ground

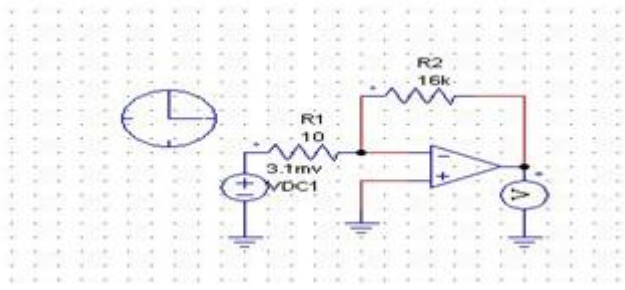


Fig 2.4 Amplifier circuit for Geophone

A geophone alters vibrations into electrical voltage which can be exactly measured. The instrument itself is based on a coil suspended by springs in a magnetic field, inside a steel case. When vibration of any category moves the case, the coil remains fixed due to its inertia. This movement of the case in relation to the stationary coil produces an electrical voltage comparative to the velocity of the coil with respect to the case. Measuring variations in the electrical voltage provides the data to regulate the frequency and intensity of the vibration.

2.2 EMBEDDED PROCESSING PHASE

In this phase we are using Raspberry pi for processing sensed data and arduino UNO board for serial \
communication. Here are some features of Raspberry pi which is given as follows:

The Raspberry Pi is a low cost, single on board computer that can be plugged into a computer monitor or TV, and uses a standard keyboard and mouse. It's capable of doing everything you would expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.
Specifications of the selected hardware is given below:

- BROADCAM BCM2836 Quad-core ARM Cortex-A7 Processor.
- Clock Frequency : 900 MHZ
- OS Support : Linux (e.g., Raspbian, Debian, Fedora, ARCH Linux ARM), FreeBSD, &NetBSD
- Python, C, C++, Java, Scratch, Ruby and any language that compiles for ARMv6.
- Provides Multimedia support like audio , video and Camera.

ARDUINO:

Arduino is an computer hardware platform which provides embedded developers to construct applications in different domains. The software part is also enhanced with arduinointegraded development environment (IDE).The Arduino programming environment posses large number of predefined library functions that helps developers to a flawless development lifecycle. All of the arduino devices have inbuilt ADC modules and hence the need for further signal conditioning hardware is naturally gets reduced. Apart from the ADC module the arduino hardware platform consists of IO ports and PWM output pins which again makes the development process easier.

The appropriate algorithm for the processors used in Embedded processing phase is given as follows:

- Note down at which port the output from the amplifier is getting connected to the arduino board.
- Boot the linux Operating system on Raspberry pi using the software win32disc Imager.
- As soon as the OS getting booted install the corresponding packages like arduinoIDE ,Twython and other required packages in Raspberry pi.
- Program the Arduino UNO board for getting serial data using Arduino IDE.
- Code the Raspberry pi using python for transferring those serial data from arduino.
- Also specify the corresponding serial port tag in which the board is connected.
- Similarly python coding must be executed for camera part.

- Thus we can combine both by specifying the corresponding threshold value from Geophone.

These are the steps to be followed in embedded phase .Finally the output from this phase must be uploaded in Cloud.Data uploading operation done using java scripts. In our project work we are using twitter as a cloud computing platform and we also building our own web page for monitoring data.

2.3 COMMUNICATION PHASE

In this phase we have to write programs for our devices to act as http client for transferring data from client side and similarly for http server. On the web , the server program which we write handles GET requests from web browsers and returns a message to them for making a device as http server. Here we can assign our secret key for using the web services for particular application. For testing application that send or receive http messages (i.e) http Clients we can use suitable tools for logging http traffic. However before delivering HTTP requests to a real web service out in the wild, you may want to know beforehand what we would send.

The IoT encompasses RESTful web services that measure or manipulate physical parameters. Thus Internet of Things ponders on the application layer and the real world things that are measured or manipulated. The term IoT focuses on the underlying network layers and the technical means for measuring and manipulating physical environment. Four basic ways in which your device may communicate with another computer on the web.

- Device is client – pushing data to a server
- Device is client – pulling data from a server
- Device is server – providing data to clients
- Device is server – accepting data from clients

In monitoring applications a device produces data (i.e) measurements from its attached sensors. For such applications, the interaction patterns 1 and 3 are suitable and data flows from the device to another computer, the device is either client(1) or server(3).

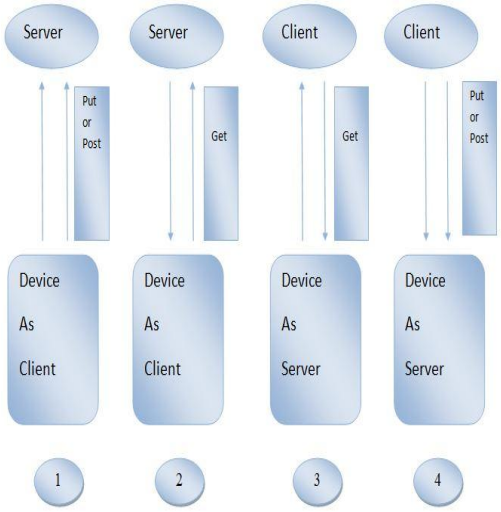


Fig 2.5 Four ways in which device can communicate with another computer on the web

2.3.1 TWITTER

In our project we are also using social media to update the current status. As for Twitter, in some ways the company is previously fairly entrenched in the world of IoT in that many machines already are connected and tweeting with Twitter through the company's own API. By now machines are sending tweets by the millions. First off, we think many connected systems will learn to read tweets and use them to set in motion "scenes" or actions .Thus Twitter is not only about connecting people to one another but about connecting machines to machines. Whether we are an individual or a company, posting a update in twitter ensures that anybody with any interest in what we are doing will have instant access to that information. However, it is not about just individuals and companies which are using Twitter to put out what they are doing and thanks to the public nature of tweets, this information can be used to drive a whole new range of 'internet of things' applications. Twitter's open API (application programming interface) allow everyone to write an app to store data from sensors placed in buildings or public areas and translate those data into 'tweet' form so that it can be posted onto Twitter. Twitter works well as a gateway API to IoT for developers because of its fluency and it is also easy to use ,but it also immediately makes it social, allowing us to establish IoT communications to a trusted network, or even the public.

Like it or not, we think many IoT devices will come pre-configured to work with our general social networks, and as the IoT world becomes influential, we will find more logical ways to communicate with these equipments in our lives—by realizing that not all needs to social and on the web, but in the early days we'll depend on these characteristics to know how to make communication between devices and sensors. Here we are creating a application in twitter application management page and have to get access to the corresponding API key by giving the required specifications of our application. The obtained API key is specified in our python code for transferring data to the social media. Depending on the condition we can set the alert mechanism in social media so that the people can evacuate the place and the forest officials can take appropriate measures.

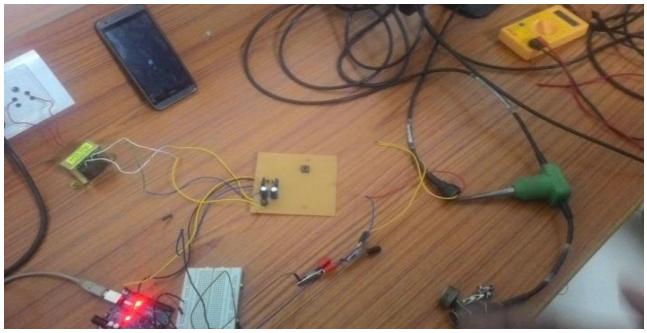
2.3.2 WEBPAGE

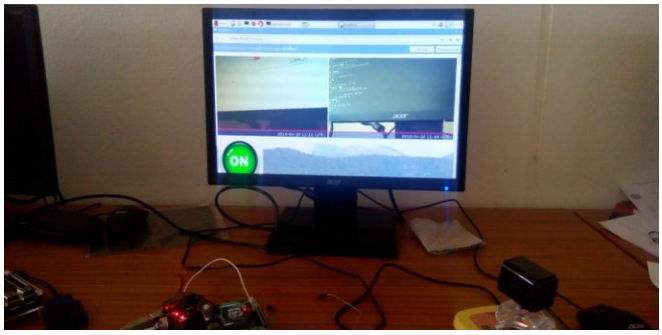
We are also creating a webpage for continuous monitoring the images taken in the forest over a specified time interval. Here we are using PHP (Hypertext Preprocessor) embedded with html to create a webpage for giving alert and gathering images taken through the camera. Here we are using PHP for efficiently accessing webpage via Raspberry Pi, also it has the advantage like free of cost , open source and has multiple layer of security. Before going to the execution of PHP code we have to install the package for apache server in the raspberry pi board. After the installation of apache server we have to place the PHP codes and the corresponding data to the respective folders. In the first phase of the webpage we have to give the authorized login ID and password for entering into the page. In the next page we will have indication for providing alert. There is also a check box available for monitoring image captured on the specified date. Thus we can either monitor lively or also can

ISSN:2319-6890)(online),2347-5013(print)
1 July 2016

have check on the previously monitored data. Generally there are two methods the client can send information to the web server, GET and POST method. Encoding is done using a scheme called URL encoding and it's done before the browser sending the information. In GET method the encoded user information appended to the page request is sent and in POST method the information is transferred via HTTP headers. Thus PHP code will be compatible for designing a alert based system for continuous monitoring.

3. EXPERIMENTAL RESULTS





4. CONCLUSION AND FUTURE WORK

Here we are developing a prototype model to prevent elephant intrusion in forest border areas and to prevent false alarm by making use of Internet of Things. In future we can implement this work in real time so that we save many lives and to avoid loss of human habitat. We can also have a survey of detected events in which elephants crossing the borders so that we can also have possibility to predict the elephants migration from the forest. Thus not only monitoring, prediction of future is also possible in Internet of Things. We can also have control and command instructions in future to have greater impact on our social issue.

5. REFERENCE

i. *Rune Brincker, Thomas L.Lago, Palle Andersen and Carlos Ventura, "Improving the Classical Geophone Sensor Element by Digital Correction".*

ii. *K. Ramkumar, B. Ramakrishnan, S. Karthick and R. Saravanamuthu,"Human and Elephant (Elephasmaximus) deaths due to conflict in Coimbatore Forest Division, Tamil Nadu, India", ZOO's PRINT, Volume XXIX, Number 8 August 2014*

iii. *Sugumar, S. J., and R. Jayaparvathy. "An early warning system for elephant intrusion along the forest border areas." Current Science 104 (2013): 1515-1526*

iv. *XU Lida, HE Wu, LI Shangcang. Internet of Things in Industries:A Survey[J]. IEEE Transactions on Industrial Informatics, 2014, 10(4):2233-2243.*

v. *CHEN Shanzhi, XuHui, Liu Dake, et al. A Vision of IoT: Applications, Challenges, and Opportunities with China Perspective[J]. IEEE Internet of Things Journal, 2014, 1(4): 349- 359*

vi. *Acceptance letter of the conference "ICOVP-2015" conducted by IIT-Guwahati for the title "ANALYSIS AND TESTING OF GEOPHONES IN DIFFERENT SOIL CONDITIONS FOR ELEPHANT INTRUSION DETECTION" on December 2015.*