

# SUMAN MAROJU

316A, Engelhart Apts, 1915 Maple Avenue, Evanston, IL 60201  
(520) 491-0337 | sumanmaroju2020@u.northwestern.edu

## EDUCATION

- Masters in Computer Science**, Northwestern University, Evanston, IL. (2016-2018 March)  
**Master in Electronics & Electrical Communication Engineering**, Indian Institute of Technology, Kharagpur, India  
(Specialization- Systems & Networking) (2013-2016)  
**Bachelor in Electronics and Telecommunication Engineering**, BPUT, Orissa, India. (2005-2009)

## EXPERIENCE

- Graduate Research at Northwestern University-HABits Lab Affiliated With Feinberg School of Medicine and Northwestern University McCormick School of Engineering (Machine learning & Wearables)** (2017 Summer & 2018 Winter)
- Developed an energy efficient hierarchical **wearable sensing system** for feeding habit monitoring of users.
  - Programmed a smartwatch based on **android platform** to detect hand based feeding gestures and trigger RaspberryPi wearable camera. Implemented **machine learning** techniques using **tensorflow and OpenCV** for the project.
- Graduate Research at Northwestern University (Artificial Intelligence)** (2017 Fall)
- Worked in a team of 3 with Kellogg counterparts to develop **AI based optimal team allocation system** based on **IBM Watson** personality insight API. Developed a web interface and grouping algorithm in python and Flask.
- Graduate Research at Northwestern University (Networks/Security)** (2016 Fall)
- Worked in a term project to setup **SDN openflow** switch with **opendaylight** as controller. Time series data traffic stats were generated and stored using **TSDR** plugin with **Hbase, Cassandra** and **Hadoop** configured at **Linux OS**.
  - Worked in **MIMO** based wireless networks security project with simulations on **WARP** boards and **Matlab** at **Rice University**.
- Project Officer at RDSO, Indian Railways (Wireless Sensor Networks)** (2014 February - 2016 September)
- Worked in a project titled "**Development of Railway Bridge Health Monitoring System with Wireless Sensor Networks**".
  - Developed an **energy efficient event based WSN system** for automated data collection, transfer and management of sensor data for health monitoring of Indian Railway Bridges. Implemented **machine learning** and **signal processing** techniques for analysis of sensor data.
- Project Officer at Intellisys Pvt. Ltd (Video Conferencing Software)** (2013 May - 2014 January)
- Worked in a project titled "**Software and Hardware integrated approach for Next generation Video conferencing**" funded by Intellisys Technologies & Research Ltd., India.
  - Worked in a Team of 4 for the development and optimization of **H.264** and **G.726** based video codec.
- Junior Research Fellow at DRDO, India (Defense Organisation)** (2012 January-2013 April)
- Worked at Communication Directorate of India's premier missile test range called **ITR (Integrated Test Range)**.
  - Worked on the upgradation and maintenance of defense communication equipment (Routers, Switches, Polycom).
  - Designed Satellite modem in **NI LabVIEW**, worked on **VOIP** hardware based on **asterisk** server.
- Software Engineer, Vizexperts. Pvt. Ltd., Gurgaon, India(Graphics Startup)** (2010 October – 2011 November)
- Worked in a team of 5 SDEs for the development of **3D GIS** (Geographic information system) software called "**INDGIS3D**" (Similar to **ArcGis** or **GoogleEarth**) for **CAIR, DRDO**, to assist Indian Army planning's.
  - Worked in a team of 5 SDEs for a remote 3D oil exploration software called "**VSite3D**" outsourced by **Landmark Graphics, Halliburton, USA**.

## TECHNICAL SKILLS

**Programming(Proficient):** C, C++, C#, Java, Matlab, HTML/CSS, JavaScript  
**Programming(Intermediate):** Android, Python, QT, jQuery, PHP, node.js, React, Meteor, Assembly, Flask, Wordpress, Git  
**API&Tools:** Tensorflow, WEKA, IBMWatson, OpenSceneGraph, DirectX, OpenDaylight, Mininet, CoAP, MQTT, XMPP, WebRTC, Asterix, OpenMP, OpenCV, CUDA, LabVIEW, NS2/NS3, ANSYS, SAP2000, ArcGIS  
**Database:** MySQL, HBase, Cassandra, Hadoop, TSDR, Spark  
**Operating Systems :** Windows, LINUX, DOS, Raspbian, Android, VMware, Docker, Heroku, AWS, GoogleCloudPlatform  
**Hardware:** RaspberryPi, Arduino, PIC, ATMEL, BLE, Bluetooth, WiFi, MIMO (WARP)

## SPECIALIZED SKILLS

Signal processing, Autoregression & Clustering analysis, Wavelet Transform, HHT, Signal compression, compressive sensing, Kalman filtering, Sensor Fusion, Machine learning, Deep learning (CNN,LSTM), Google Location based Services, Video Streaming (H264, G.726), RTP, RTSP, Synching, Traffic shaping, policing, QOS, congestion control and routing techniques, OpenFlow, SDN, Big Data, IOT, WSN, MIMO Wireless systems, Internet Security, Web development.

## LEADERSHIP ACTIVITIES & HONORS:

- Led the team at **Robotics** competition held at Kshitij at IIT Kharagpur, India. (**During Bachelors**)
- Given training on topic of routers & switches for a course titled "**Telecommunication Networks with State-of-the-Art Hands-on Experiments**". (**During Masters**)
- Networking certifications in **CCNA** and **RHCE** at **IIHT**.
- Participated in Entrepreneurship activities at Entrepreneurship Cell IIT, Kharagpur, India.
- Selection at National level Science Exhibition for the project titled "**DNA Fingerprinting**" during higher secondary.

## PUBLICATIONS:

Soumendu Kumar, Maroju Suman, Raja Datta, and Prabir Kumar Biswas. "**Power efficient event detection scheme in wireless sensor networks for railway bridge health monitoring system.**" In Advanced Networks and Telecommunications Systems (ANTS), 2014 IEEE International Conference on, pp. 1-6. IEEE, 2014.

## MY CONTRIBUTIONS IN THE DEVELOPMENT OF VARIOUS SCIENTIFIC COMPUTATION SOFTWARES /HARDWARE SYSTEMS AT DIFFERENT ORGANISATIONS:

### INDIGIS3D A GRAPHICS GIS (GEOGRAPHIC INFORMATION SYSTEM) at Vizexperts India Ltd (2010-2011)

A GIS software developed by us (a team of 5) at Vizexperts, India, Pvt. Ltd for CAIR, DRDO. The figure 1 below shows different filters implemented for performing various scientific computations on raster and vector files like Dem data, population or any other statistical data over terrain.

**Languages and tools used:** C++, Openscenegraph, Opengl, shell scripting, buildbot, CVS



Figure 1: Snapshot of INDIGIS3D software developed.

### VENNFER HD: H.264 and G.729 BASED CODEC DEVELOPED FOR REAL TIME VIDEO CONFERENCING FOR INTELLISYS TECHNOLOGIES & RESEARCH LTD: (2013-2014)



Figure 2. Snapshot of “VennferHD” Video conferencing software.

Worked in a team of 4 for the development of a video conferencing software based on H.264. Figure 2 shows a snapshot of Video conference system developed. I did various performance improvements in Video and Audio streaming. Worked on RTP and multicast protocols for streaming over network in unicast and multicast scenarios. Did various QOS optimizations for the improved streaming performance.

**Languages and tools Used:** C, C++, VP8, Directshow, RTP, Multicast, G.729, H264 format

### RBHMS: RAILWAY BRIDGE HEALTH MONITORING SYSTEM BASED ON WIRELESS SENSOR NETWORKS FOR RDSO, INDIAN RAILWAYS (2014-2016).

Developed an energy efficient system using an SBC (Single board Computer- RaspberryPi) to automate event based data collection and transfer of sensor data from Indian Railway Bridges using IoT protocols in constrained networks. The user interface and sensor management is entirely developed by me. (Figure 3-4). Also worked extensively on the Machine learning aspects and signal analysis for damage detection in bridges from the accelerometer and strain data obtained from the sensors attached to the bridges.

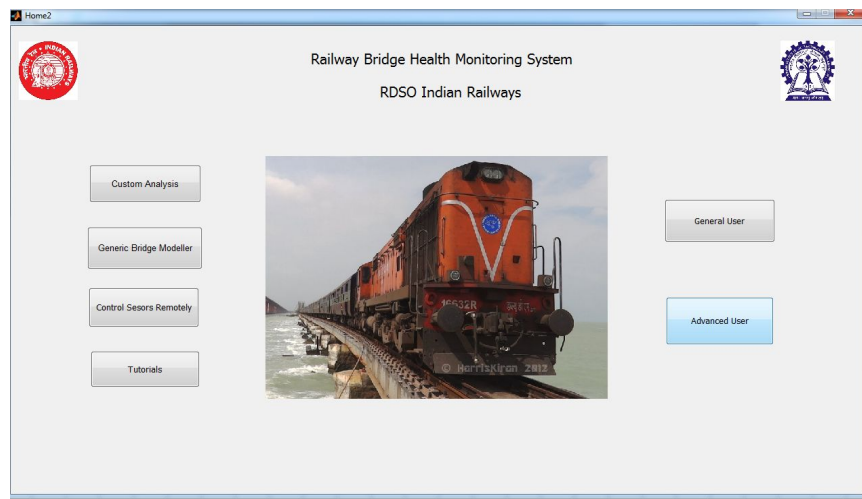


Figure 3. User Interface RBHM system developed for Indian Railways.

The **RBHMS** software allows various signal processing and machine learning algorithm to be applied to sensor data for detection of damages and analysis of current state of the structure. The software also assists in modeling the structure efficiently.

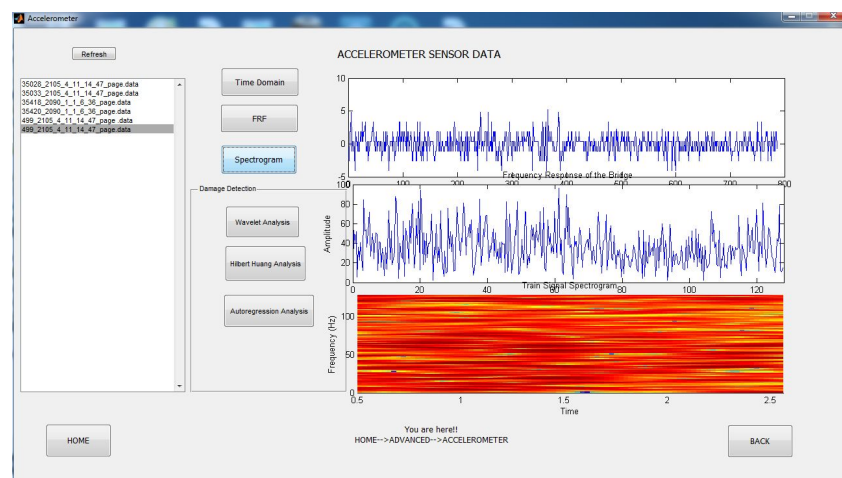


Figure 4. Sensor Analysis Tab for RBHM system.

Automated event triggered wireless sensor data collection system developed for the **RBHM** project is shown in left figure 5. Figures in Right shows Screenshot of CoAP protocol based Client and Server used for sensor data transfer from constrained networks to remote analysis server.

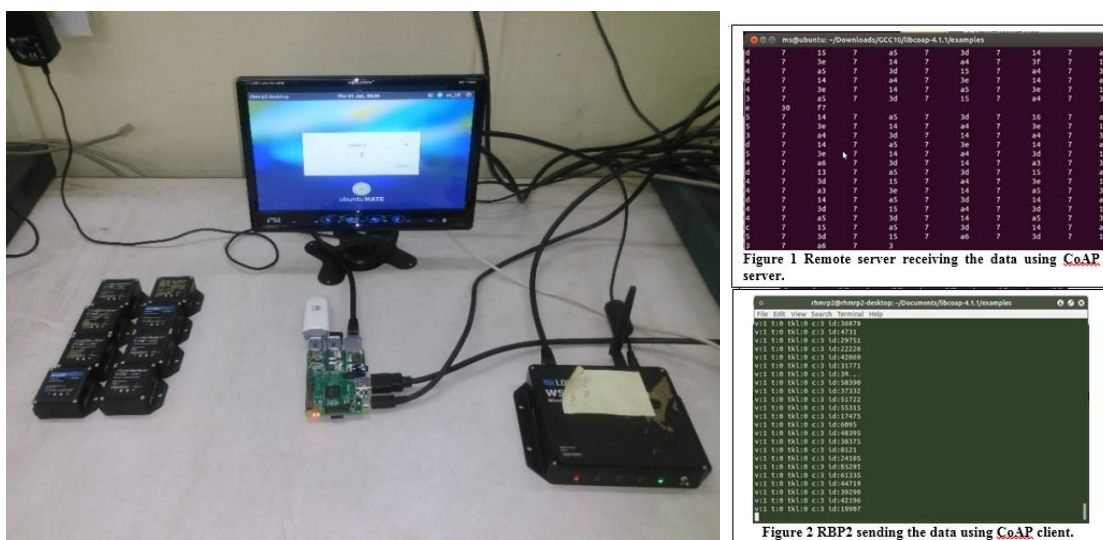


Figure 5. RBHM system developed for the project.

**Languages and tools used:** ASM, C, Matlab, RaspberryPi, Accelerometer and Strain sensors (WSDA 1500, G link sensors), Coap protocol, Autoregression analysis, moving averages, GSM.

### 3 TIER FLOOD WATER MONITORING SYSTEM SOFTWARE DEVELOPED FOR INDIAN RAILWAYS:

An SMS based alerting system developed for Indian Railways to monitor flood levels and send 3 tier SMS based on the water level detected by radar based water level sensor.

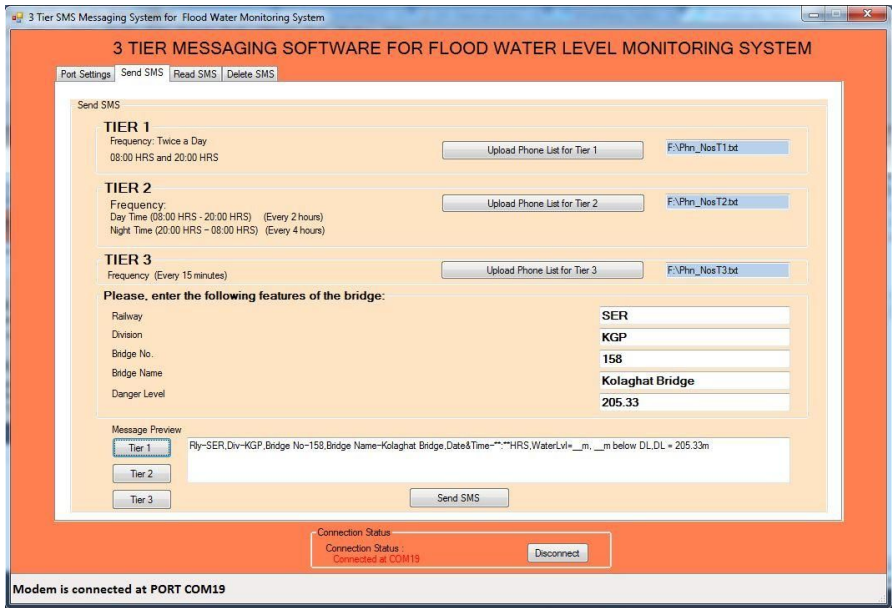


Figure 6. Automatic 3 Tier Messaging System for Flood Monitoring.

**Languages and tools Used:** C# and SMS AT commands

**PROJECTS DONE AT NORTHWESTERN UNIVERSITY (2016-2018)**

**TEAMUP PROJECT: OPTIMAL TEAM ALLOCATION SYSTEM BASED ON IBM WATSON PERSONALITY INSIGHT API (2017 Sep-2017 Dec)**

Worked in a team of 3 for the development of a AI based optimal team allocation system that can group a set of individual into teams such that each team is balanced in term of more than 70 personality characteristics obtained from IBM Watson personality insight API. Wrote round robin based team allocation algorithm in python and worked in the implementation of web interface using Flask.

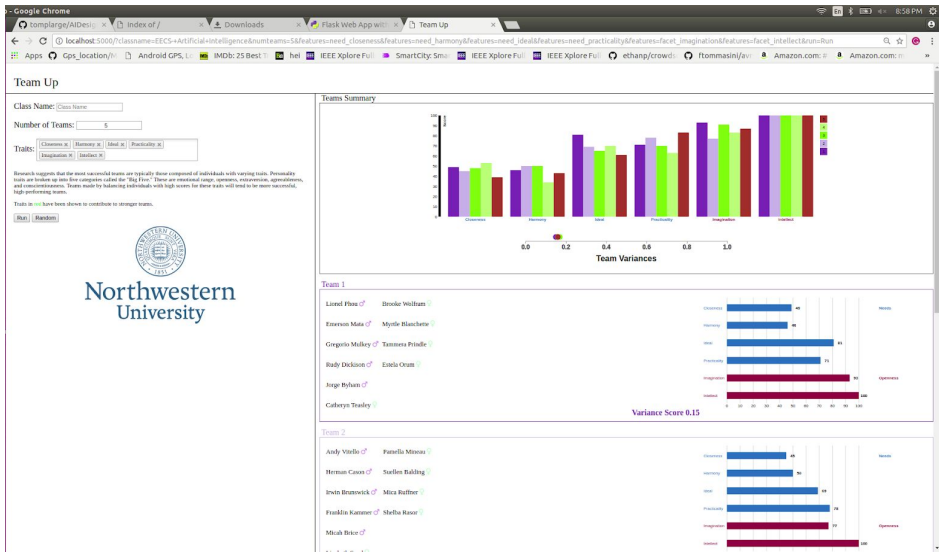


Figure 7. TeamUp web interface to upload team information and create optimal teams and view each team statistics.

**Languages and tools Used:** Python, Flask and Web technologies (HTML, CSS, Javascript)

**SAFEMAP: A CRISIS MANAGEMENT APP DEVELOPED FOR DESKTOP AND MOBILE DEVICES**

The project allows the users in crisis such as floods, earthquake etc to report their location and and visualize crisis using the heatmaps on a web or mobile device. Built using Javascript, HTML and CSS.



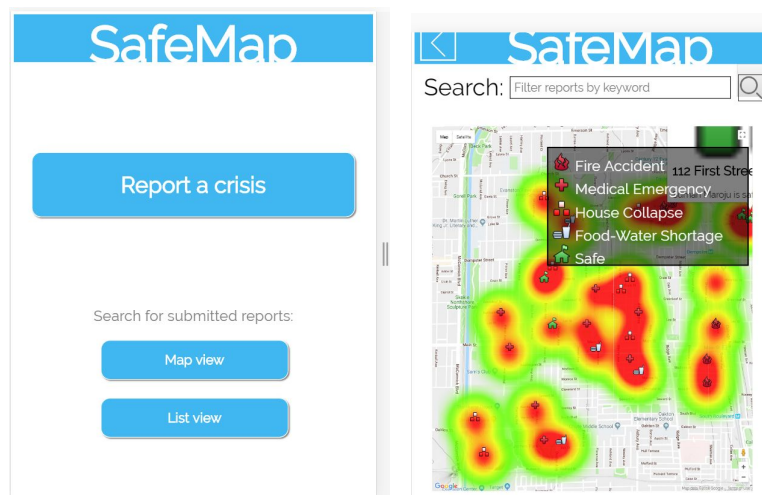


Figure 8. Main page and Map view page of the SafeMap app.

**Languages and tools used:** Javascript, CSS, HTML, Google location services.

Github link: <https://github.com/brotatotes/SafeMap>

### BIKE WATCHDOG: AN ANDROID BASED SYSTEM FOR DETECTION OF BICYCLE THEFT AND LOCATING BASED ON LIVE LOCATION UPDATES

Figure 7 shows the interface developed on android device to input the user phone number and the bluetooth MAC address on the device attached to the bike. The figure shows the sms received at the phone when the bike moves (indicating possible theft).

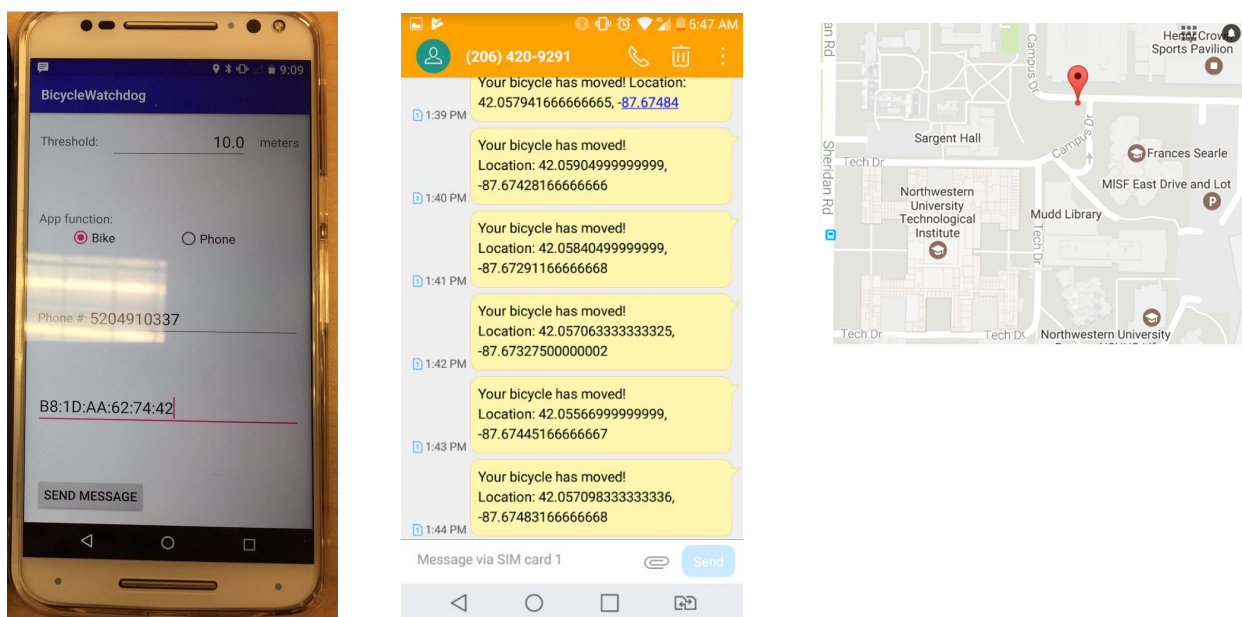


Figure 9. First figure from left shows the view at the device attached to the bike and the second figure shows the live sms alerts received at the user phone. Third figure shows the location of the moved bike plotted on the google maps.

**Languages and tools used:** Android, Google location API, Bluetooth manager, SMS API.

<https://github.com/aiqiliu/Bike-Watchdog>

### SDN BIG DATA FAULT ANALYSIS- DIAGNOSIS FRAMEWORK & DATA COLLECTION

Project done in a team of two on SDN big data fault analysis. Project involved setting up of the.opendaylight boron and associated frameworks for fault analysis such as TSDR, Hadoop, Spark HBASE, Cassandra for the collection and analysis of various networking faults and statistics. Various traffic statistics collected include OpenFlow Statistics, Flow Stats, Flow Table Stats, Meter Stats, Group Stats, Port Stats, Queue Stats, SNMP, NetFlow, sFlow, Syslog, Controller Metrics

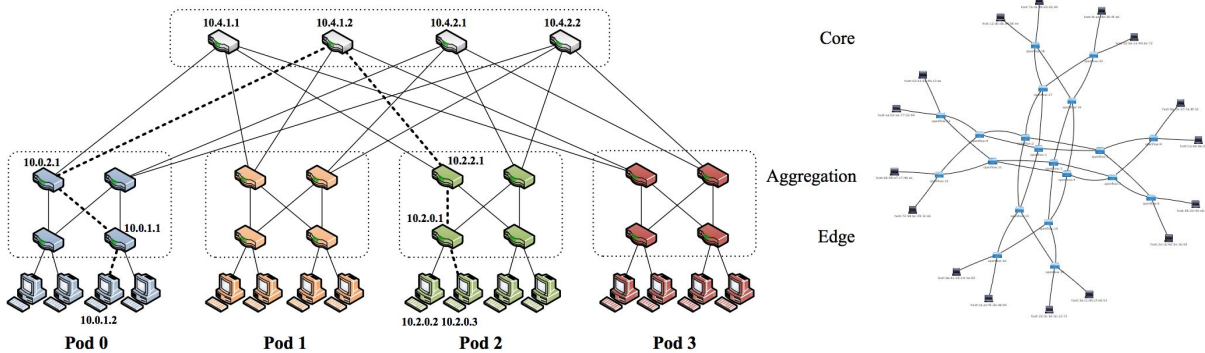


Figure 9. Mininet based network with 4 core switches, 8 aggregate and 8 edge switches and 16 hosts used for the project.

```

→ distribution-karaf-0.5.0-Boron cd bin
→ bin ls
aggregationTest      instance      set_persistence.sh status.bat
client               karaf        shell.bat         stop.bat
configure-cluster-ipdetect.sh karaf.bat    start
configure_cluster.sh setenv       start.bat
custom_shard_config.txt setenv.bat   status
→ bin ./client -u karaf
Logging in as karaf
800 [sshd:SshClient[18ce0030]-nio2-thread-2] WARN org.apache.sshd.client.keyverifier.AcceptAllServerKeyVerifier
RSA, 0e:cc:69:45:38:b2:40:5f:dc:07:9e:11:fe:75:40:a2] presented unverified {} key: {}

OpenDaylight

Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown OpenDaylight.
opendaylight-user@root>

*** Ping: testing ping reachability
h1 -> X h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h2 -> h1 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h3 -> h1 h2 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h4 -> h1 h2 h3 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h5 -> h1 h2 h3 h4 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h6 -> h1 h2 h3 h4 h5 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16
h7 -> h1 h2 h3 h4 h5 h6 h8 h9 h10 h11 h12 h13 h14 h15 h16
h8 -> h1 h2 h3 h4 h5 h6 h7 h9 h10 h11 h12 h13 h14 h15 h16
h9 -> h1 h2 h3 h4 h5 h6 h7 h8 h10 h11 h12 h13 h14 h15 h16
h10 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h11 h12 h13 h14 h15 h16
h11 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h12 h13 h14 h15 h16
h12 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h13 h14 h15 h16
h13 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h14 h15 h16
h14 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h15 h16
h15 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h16
h16 -> h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15
*** Results: 0% dropped (239/240 received)
*** h1 : ('ITGRecv &')
[1] 25832
10.0.0.1
*** h2 : ('ITGRecv &')
[1] 25833
10.0.0.2
*** h3 : ('ITGRecv &')
[1] 25834
10.0.0.3
*** h4 : ('ITGRecv &')
[1] 25835
10.0.0.4
*** h5 : ('ITGRecv &')
[1] 25836
10.0.0.5

```

Figure 10. Opendaylight based SDN collecting various network statistics (Layer-4 data collected, protocols: TCP, UDP, ICMP, DCCP, SCTP, Layer-7 data collected, Predefined stochastic PS (Packet Size) and IDT (Inter Departure Time) profiles: CounterStrike (active and inactive), VoIP G.729)

**Languages and tools used:** NFV, SDN, mininet, Hadoop, Spark, Hbase, Cassandra and traffic generators

## TRIGCAM: A SMARTWATCH TRIGGERED WEARABLE CAMERA SYSTEM FOR EFFICIENT FEEDING HABIT MONITORING (2017 June-2018 March)

Developed a system called TrigCam for feeding gesture monitoring of users. TrigCam system consists of a smartwatch paired with an android smartphone to trigger the recording of the videos at a raspberry pi based fisheye camera (TrigCam). TrigCam records the feeding videos from a first person perspective only when feeding gestures are detected at the smartwatch worn by a user. Smartwatch triggers the phone and phone relays the triggers to the TrigCam to start 20 seconds of video recording at TrigCam for a trigger. Multiple consecutive triggers occurring in 20 seconds window are considered as a single Trigger to avoid backlogging of triggers.

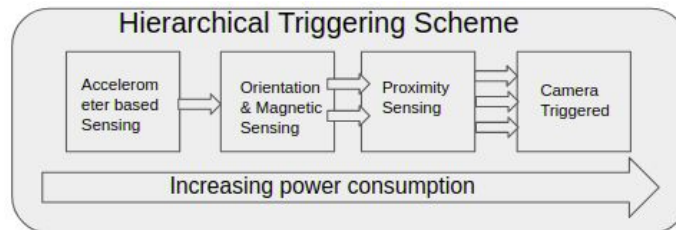
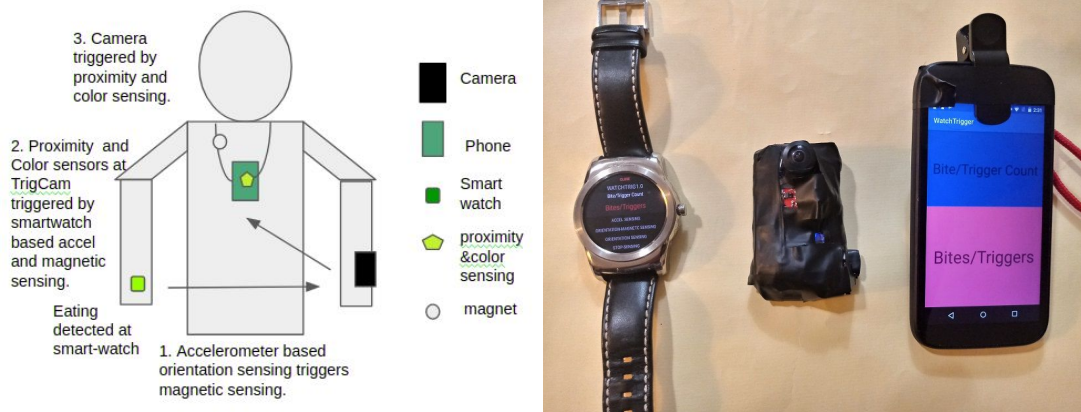


Figure 7. Smart Watch Triggered Wearable Camera System

**Languages and tools used:** Android, python, Java, RaspberryPI zero, Orientation, Magnetic and Accelerometer sensors of a smartmatch, sensor fusion based on google android API,, bluetooth, Wifi scripts, Syncthing, Fish eye lens, OPENCV, Tensorflow and weka for training the system.

**Github link:** <https://github.com/Maroju100/TrigCam>