USER MANUAL

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Status

Revised		
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PROJECT IDENTITY

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Document History

Version	Date	Changes	Initiated by	Executed	Revised
1.0	2013-12-06	Approved version	Internal Client	Johan	Emma
0.3	2013-12-05	Third draft	Internal	Johan	Emma
0.2	2013-12-05	Second draft	Internal	Kristian	Emma
0.1	2013-12-04	First draft	Internal	Linus	Kristian

1 INTRODUCTION

This user manual treat the all the necessary steps to set up and run the system “Acoustic control of surveillance camera”. The manual is developed by the ASO group whom also created the ASO system during the autumn 2013 as a CDIO project at Linköping University.

For more information of how the system is structured and its functionality see the project’s technical documentation.

2 HARDWARE

Short summary of the included hardware components:

- AXIS 233D Camera – Surveillance camera that communicates with the system via http requests and have implemented auto focus.
- AKG CBL99 Microphones – Eight microphones that have a flat design to avoid sound reflections from the floor.
- M-AUDIO Fast Track Ultra 8R Soundcard – Can record audio from up to eight microphones simultaneous at a selected sample rate.
- Server computer – A computer with Ubuntu as operating system and an USB port as well as Ethernet connection possibilities.
- Sound source – The sound source shall be able to play a sound file of the format .wav, e.g. a mobile phone.

2.1 Hardware initialization

1. Fix the camera in the ceiling and connect it via Ethernet cable to a computer or a router.
2. Deploy the microphones on the floor and connect them to the sound card. Four sensors or more are needed for a good result.
3. Connect the soundcard via USB to the computer.
4. Download the provided “superchirp.wav” to your sound source device.

2.2 Camera server initialization

1. Connect the camera to a router.
2. Find it's IP address using Axis IP Utility:
   http://www.axis.com/techsup/software/iputility/
3. Type its IP address in the URL-field of an internet browser. Press Enter.
4. Go to "Setup", "Basic configuration" and then "TCP/IP".
5. Use the following IP-address: 192.168.0.90, see Figure 1.

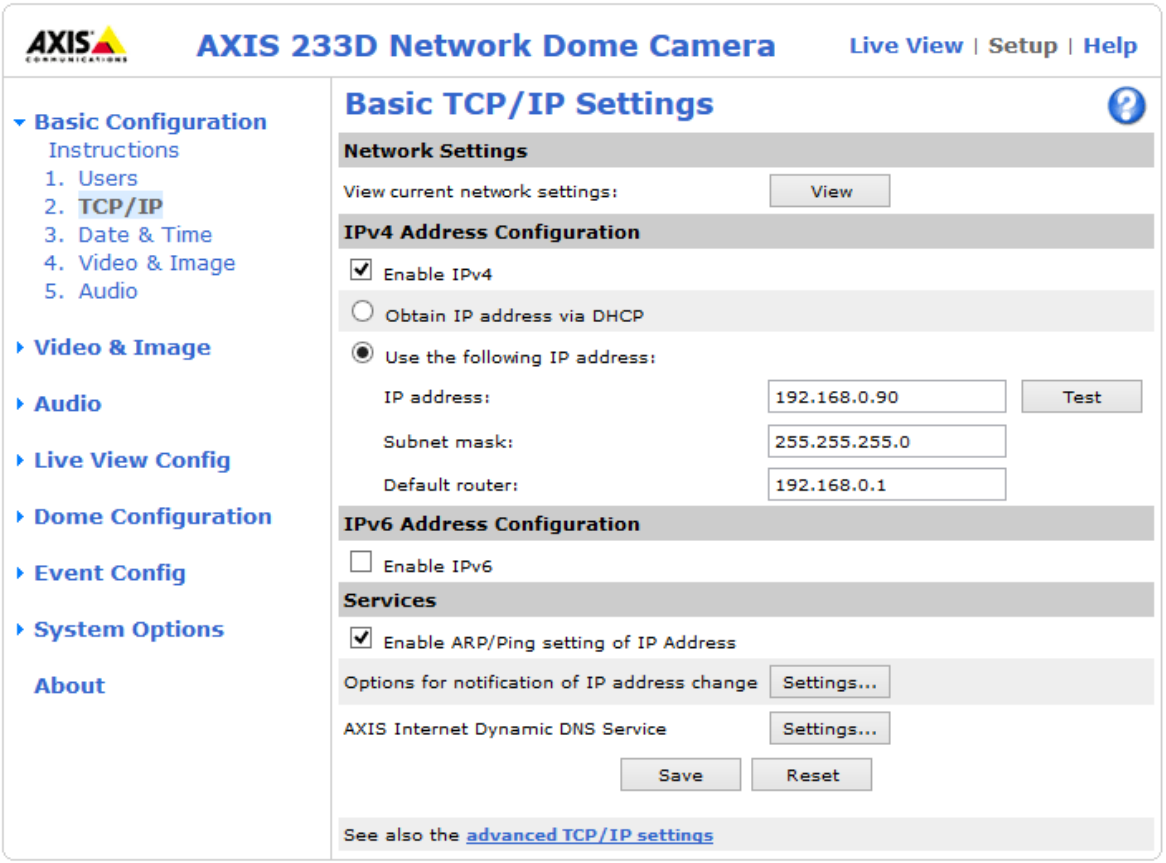

Figure 1. Setting the camera server to have a static IP-address.

3 SOFTWARE

Short summary of the necessary system files:

- A shell script will initiate the user program
- Several shell-scripts will be included in a folder to be able to start the other dependencies.

3.1 Software initialization

1. Install Ubuntu 12.04.
2. Install ROS (Robot Operating System).
3. Install all necessary libraries, see Appendix A.
4. Download the project code.

3.2 Multiple machines

If the system is to run on multiple machines, the following two steps needs to be performed:

1. Synchronize your machines to one system clock by for example using a NTP-server.
2. Change certain environment variables in ROS. Every node represented by a script in the RUN_SCRIPT folder needs to have the following environment variables added:
    a. export ROS_MASTER_URI=http://master-ip:11311/
    b. export ROS_IP=local_node_ip

Where the master-ip is the IP-address of the computer which the ros master is running on, and the local_node_ip is the IP-address of the computer where the node is running.

4 START UP

Before running the system, the desired modules have to be connected and a calibration of the sensors' positions and the camera position has to be performed. Note that the latter only needs to been done at start up while the previous can be done as many times as wished. Both procedures are described thoroughly below.

4.1 Connect modules

When you run the script run_all.sh the GUI in Figure 1 will appear. First of all the modules have to be connected, this is done by pressing the "Connect all modules" button. If you don't want to run all modules at the same time, use the "Connect" button for each module. To disconnect any or all module, press the respective button once more.

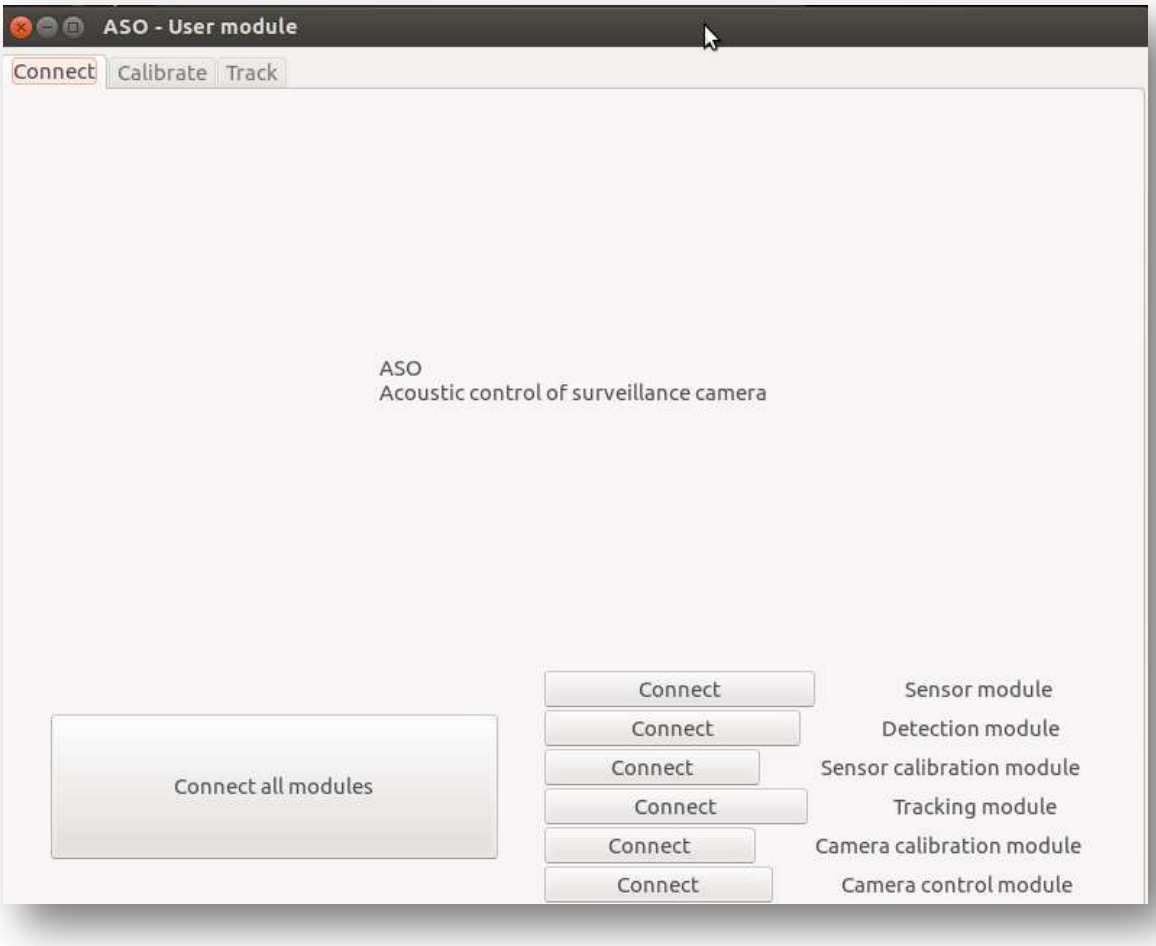

Figure 2. GUI with the Connect tab open.

4.2 Calibration

Before the system is able to run properly it has to be calibrated. The calibration is divided into two parts, the sensor network calibration to the left and the camera calibration to the right, as seen in Figure 2.

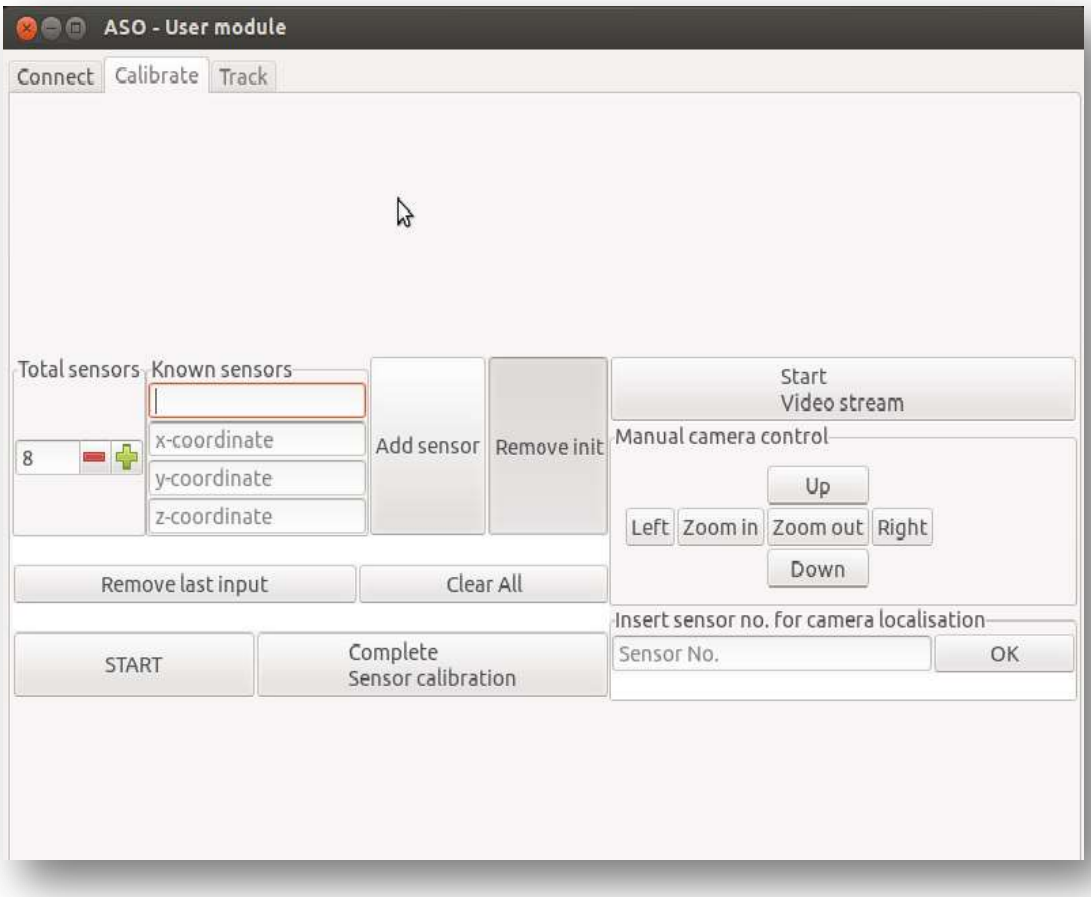

Figure 3. GUI with the Calibrate tab open.

4.2.1 Sensor network calibration

1. Enter the Calibrate tab.
2. Select the number of sensors/microphones that are connected to the system.
3. If some sensor positions are known insert them one by one under “Known sensors” and press the button “Add sensor”. Each added sensor will appear in the white area under the button.
    (a) If a sensor is incorrectly added press “Remove last input”.
    (b) Press “Clear all” to remove all the added sensors.
4. Press “Init sensors” to calibrate all the sensor positions. Sensor positions corresponding to each of the selected number of sensors appears.
5. Place the sound source close to a sensor and press “Start” to begin collecting data. After 8-10 pulses, press ”Stop” and make sure the sensor has a distance to each of the other

sensors. Perform this step for each sensor. If some sensors have invalid values, redo the calibration for either of the effected sensors.

6. Press the “Complete sensor calibration” button that appears after every sensor has a distance to every other sensor.

4.2.2 Camera calibration

1. Enter the Calibrate tab.
2. Start the video stream by pressing the “Start Video stream” button.
3. Steer the camera with the manual camera control buttons so that a selected sensor is at the centre of the video screen.
4. Input the number of the selected sensor from step 3 in the “Sensor No.” field and press OK.
5. Redo step 3 and 4 for additionally two sensors.

5 TRACKING

When the initialization of the system and the necessary start up procedures is completed the system is ready to use for tracking a target.

1. Make sure that the video stream window is open, if not go to the calibration tab and press "Start Video stream"
2. Enter the Track tab.
3. Place the sound source in the sensor network, moving or stationary, and play the superchirp.wav audio file.
4. Press "Turn on Tracking/Automatic mode" to start the tracking.
5. The tracking can now be enjoyed in the camera view.

Enjoy!

6 VIEW THE RESULT

The target that is tracked will appear in the live video stream. If no target is detected or a tracked target is lost the camera will follow the latest predicted direction, i.e. going in a straight line from where the target was heading, before new detections is received.

7 TROUBLESHOOTING

If the system crash i.e. the GUI don't react to any commands or there is no reaction when sound is played. Try to restart the system and redo the set up steps.
Problems with inaccurate tracking could be the result of several different causes. The main source of error is the environment, if the sensors are placed such that the sound is reflected false detections may occur. Try to place the sensors further away from walls and other reflective surfaces, also try to cover problematic surfaces with a less sound reflective material e.g. textile.
The tracking algorithm is using a constant velocity motion model which might have trouble keeping track on a target if it performs several fast turns.

Try to redo the calibration step. If the calibration is done wrong the system won't be able to track properly. Adding known sensor positions may give a more precise calibration.

If the trajectory looks proper but the video stream does not see the target, try to redo the camera calibration. Using sensors with known positions for the camera calibration may give a better result.

The tracker can always be turned on and off again to reset the target position using a coarse estimation.

8 SHUTTING DOWN THE SYSTEM

To shut down the system simply close the GUI by pressing the cross in the top left corner. Then manually close down the open module windows and the ROSMASTER. To turn of the sound card there is a button on the front of the card. To turn of the camera there is a small black button underneath the dome.

9 FURTHER INFORMATION

For further information please visit the project website where you will find more documentation.
http://www.isy.liu.se/edu/projekt/reglerteknik/2013/aso/

APPENDIX A – NECESSARY SOFTWARE

In addition to libraries included in the Linux kernel, the following are needed to get the system running:

- **asound** - newest version can already be included in your Linux kernel. Is necessary for the sound card.
- **itpp, FFTW, LAPACK, BLAS** – is needed for various mathematical operations.
- **gtkmm-3.0** – for the GUI
- **libcurl** – supports HTTP-requests.
- **gstreamer-0.10** – necessary for playing the video stream.
- **minpack** – for optimization functionality in camera calibration.