

UNATTENDED GR SENSOR (UGS) SYS

UGS Sys Architecture

1. The sys comprises of three basic comps incl **Sensor Node**, **Media Exch Gateway (MEG)**, Comd, and Con & Int (**C2I**) sta (laptop), & where nec a **router/relay node** to enhance comm rg of the sys. Each sensor node is equipped with multiple active and passive motion detection sensors incl Passive Infrared (PIR) Sensor, Microwave (MW) Sensor, and Seismic Sensor, a radio comm device (Zigbee) and a nav module housed in a fibreglass stone. Whenever a sensor node detects some intrusion the info is passed wirelessly to MEG which tpt it on Ethernet cable to C2I sta where wng is displayed on satellite imagery/map. The UGS sys works in real time. The UGS sys is powered by btys and hybrid solar power arng. Pictorial view of UGS sys depl around a def post is shown in fig.1. Details of the UGS sys comps are covered in succeeding paras.

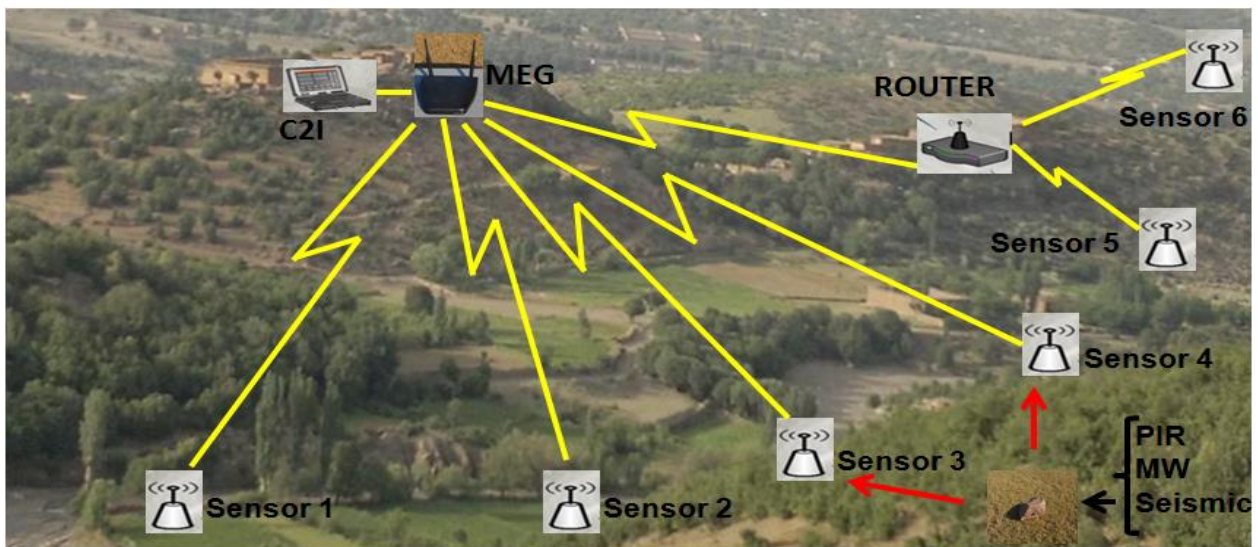


Fig.1 UGS depl around a def post

- a. **Sensor Nodes.** Main comps of the sensor node are sensors, sig processing electronics cct board, nav module and a bty housed in waterproof fibreglass stone. Three diff types incl PIR, MW and Seismic are used as sensors. PIR and Seismic sensors are passive while MW is an active sensor. Passive sensors acquire int from its surroundings due to change in envmt or vibrations without generating energy while

active sensors generate energy for detection. Working principle of sensors is described as under:

- (1) **PIR**. The sensor detects Infrared freq rg from 0.300-430THzemitted from humans. PIR sensor has a detection rg of 25-30ft and Fd of View (FOV) of 100deg. The sensor node can have more than one PIR sensor to enhance the FOV as shown in fig.2.



Fig.2 Standalone PIR sensor (left image), and PIR sensor instl on a fibreglass stone (rt image).

- (2) **Seismic**. The sensor detects low freq (0-120Hz) generated by footsteps, It veh, hy veh and flying objs. Seismic sensor has a detection rg of 150ft all-round. Fig.3 shows Seismic sensor and typical depl model.



Fig.3 Standalone Seismic sensor (left image), and Seismic sensor instl with a fibreglass stone (rt image)

- (3) **MW**. It is an active sensor which works on the principle of RADAR in X-Band (10.525GHz) freq. The detection is caused by a change in receive freq shift caused by moving body in sensor FOV. The detection rg is 20-25ft & FOV is 60deg. MW is instl alongside PIR sensor to enhance detection cap. Dual sensor instl in a sensor node is shown in fig. 4.

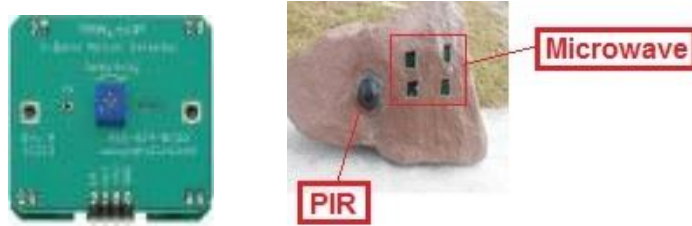


Fig.4 Standalone MW sensor (left image), and MW sensor instl with a PIR in a fiberglass stone (rt image)

- b. **MEG**. MEG is an int media exch module equipped with Zigbee radio module to process data received from sensor nodes and tpt it to C2I over wired Ethernet cable. MEG performs data collection, filtration, and tn to C2I in real time. Sensor data incl initialization msgs (generated by sensor node as soon it is switched on), bty status and alert msgs on an event of motion/intrusion detection. MEG is shown in fig.5.



Fig.5 Media Exch Gateway (open box layout)

- c. **C2I**. C2I sta has a graphical user interface to view sensor node op in real time. It performs geo tagging of sensor nodes on satellite imagery/maps. The C2I (software appl) is based on a Client-Server architecture which enables multiple users to have a real time view of sensor nodes network as shown in Fig.6 (screenshot view). C2I app displays sensor node id, geo loc (lat/lon) and alert msg (motion/intrusion detection msg). Fig.7 shows an alert msg from Sensor node id 57. The alert msg is depicted by red circles animation and audible alarm generated for 30 secs.

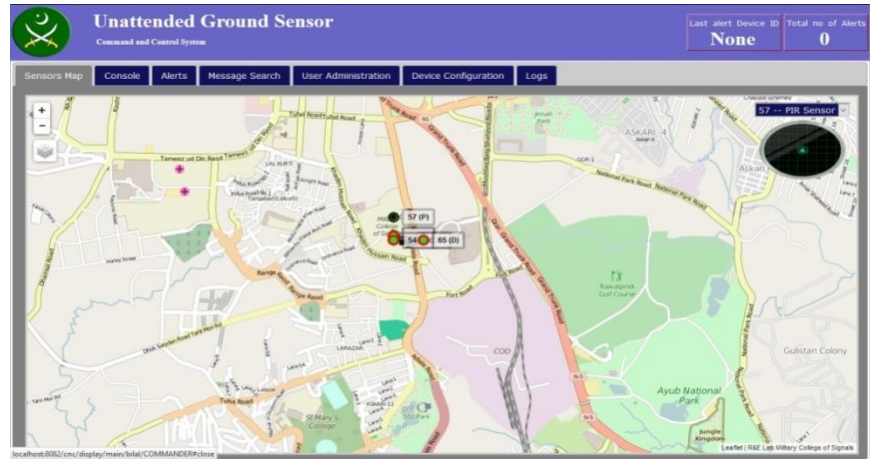


Fig.6 Map of sensor nodes on C2I display, active sensor node is shown as green disc with red circular bdy, while black disc indicates sensor dead/off.

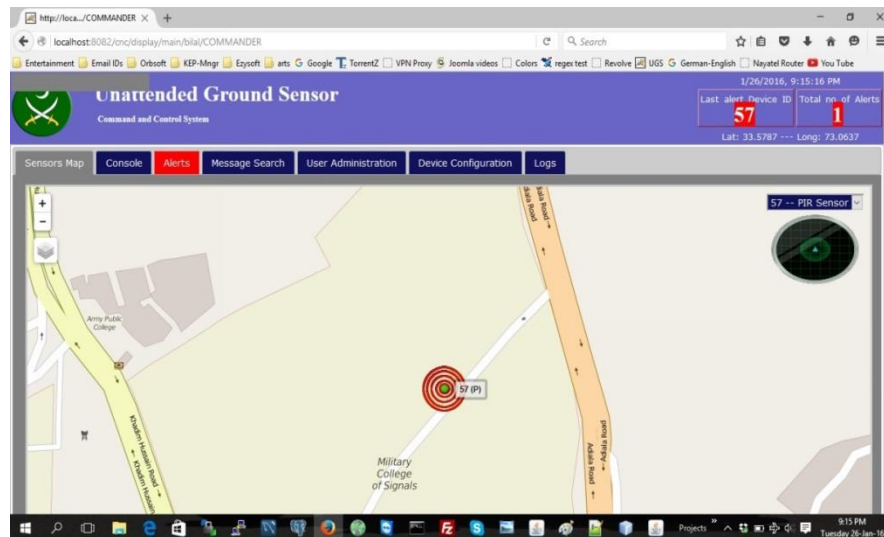


Fig.7 Alert msg of sensor node on C2I display shown as red circles animation and audible sound/alarm generated for 30 secs

- d. **Zigbee Comm.** UGS sys sensor nodes comm with MEG using Zigbee comm module. The device works around 900 MHz freq band with inbuilt tx and comm security features to avoid interception or decryption of msgs by unintended users. The basic comm network design used by UGS sys is star topology in which MEG serves as central hub to which all sensor nodes are connected. The comm rg is 300-400m extendible by 300-400 using a router/relay node. Fig.8 is ref for UGS sys star topology network design.

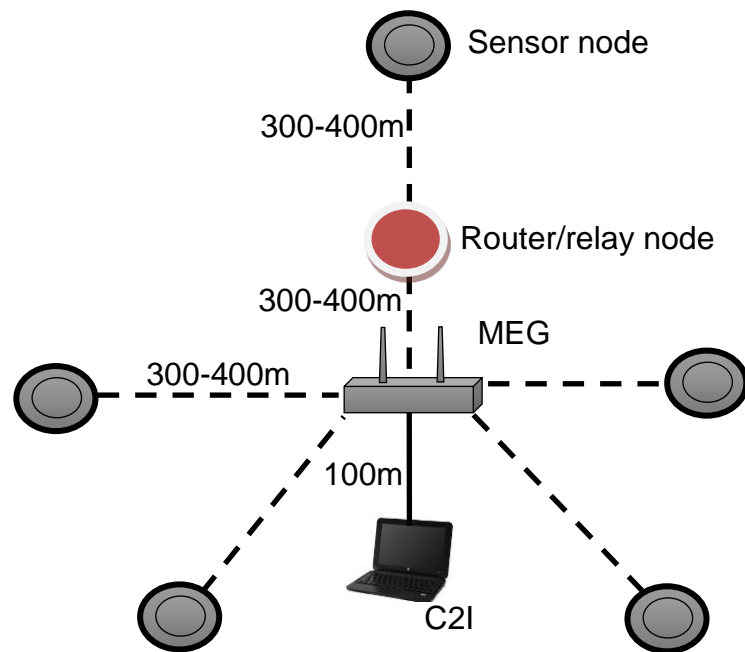


Fig.8 Star shaped topology design architecture of UGS, dotted lines depict Zigbee wireless comm and straight line for Ethernet cable connection.

- e. **Power Sys.** UGS sys for sensor node is powered by 3.7VDC, 10400mAhC Li-Ion bty which provides 60 x days of continuous op, MEG and C2I powered by hybrid power arng (solar/main AC) with 4 x solar panels (150W each) and 12VDC, 150AHC bty which provide uninterrupted power backup.