A SURVEILLANCE AND TARGETING SYSTEM
FOR AN
UNMANNED GROUND VEHICLE

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ROLES FOR RSTA PACKAGE

- DAY/NIGHT SURVEILLANCE
- REMOTE FORWARD AREA FIRE CONTROL
  - FOR ARTILLERY AND AIR SUPPORT MISSIONS
- TARGET IDENTIFICATION AND TRACKING
- ACTIVE TARGET DESIGNATION
  - HELLFIRE MISSILE
  - COPPERHEAD SMART MUNITION
MAJOR SYSTEM ELEMENTS

- SCISSORS LIFT
- PAN/TILT MOTION PLATFORM
- SENSOR SUITE
- PROCESSING/COMMUNICATIONS
SYSTEM DESIGN CONSTRAINT

USMC DIRECTION:
USE EQUIPMENTS IN THE INVENTORY WHERE AVAILABLE
  - TO MINIMIZE LOGISTICAL SUPPORT REQUIREMENTS
  - TO MINIMIZE SYSTEM TRAINING REQUIREMENTS

SYSTEM DESIGN CHALLENGE:
  - EQUIPMENTS NOT DESIGNED FOR REMOTE OPERATION
LIFT DESIGN

- SCISSORS DESIGN
- ELECTRIC: DC BALL LINEAR ACTUATORS
- FOOTPRINT: 47" LONG BY 24.5" WIDE
- STOWED HEIGHT: 20"
- LIFT WEIGHT: 470 LB
- RATED PAYLOAD WEIGHT: 250 LB
  (WITH 2:1 DESIGN MARGIN)
LIFT PERFORMANCE

VARIABLE DEFILADE DEPLOYMENT:
- 15 FEET MAX HEIGHT (EURO THEATER STUDIES)
- 9.25 FEET TRAVEL

SPEED (200 LB LOAD):
- RAISE IN 31 SECONDS
- LOWER IN 28 SECONDS

STABILITY IN 20 KNOT GUSTING WIND:
- DESIGN GOAL: 300 MICRORADIANS
- MEASUREMENT: < 50 MICRORADIANS
MOTION PLATFORM DESIGN

ELECTRIC PAN/TILT DRIVE
- DC SERVO GEARED DRIVES
- 14 BIT POSITION RESOLUTION

FOUR CONTROL MODES:
- POSITION CONTROL (HIGH/LOW GAIN)
- VELOCITY CONTROL (HIGH/LOW GAIN)
- TRACKING OUTPUT
  (TO ALLOW SLAVING, POSITION REPORTS)
MOTION PLATFORM PERFORMANCE

MAXIMUM PAN/TILT SLEW RATE
- DESIGN GOAL: 28 DEG/SEC, CORRESPONDING TO 100 KM/HR TARGET AT 100 METERS RANGE
- MEASURED: 26 DEG/SEC

MINIMUM CONTROLLABLE SLEW RATE
- DESIGN GOAL: 0.1 DEG/SEC, CORRESPONDING TO 2 KM/HR TARGET AT 3 KM RANGE
- MEASURED: 0.15 DEG/SEC
SENSOR SUITE

LASER RANGER/DESIGNATOR
AN/PAQ-3 MULE (MFR: HUGHES)

FLIR
AN/TAS-4 (MFR: KOLLMORGEN)

ACOUSTICAL DETECTION SYSTEM
ADS (MFR: NOSC)

LLL/ZOOM VIDEO
(MFR: NOSC)
AN/PAQ-3 MULE CHARACTERISTICS

- LASER
  NDYAG LASER, 1060 NM (1.06 MICRONS)
  80 MILLIJOULES/PULSE, NOT EYE SAFE

- TIME-OF-FLIGHT RANGER
  MAXIMUM RANGE: 10 KM
  MINIMUM RANGE: ADJUSTABLE DOWN TO 170 M
  PRECISION: 10 M

- DESIGNATOR: PROGRAMMABLE CODING
  30 PULSES/SEC MAX

- CONTROL INTERFACE: RANGE/DESIGNATE MODE,
  MULE POWER ON/OFF, CAMERA POWER ON/OFF,
  TRIGGER ON/OFF, RANGE DATA ACQUISITION
AN/TAS-4 FLIR CHARACTERISTICS

- 128 ELEMENT ARRAY
  MECHANICALLY SWEPT TO GENERATE 2-D IMAGE
- CENTER FREQUENCY: APPROX 10 MICRON
- FIELD OF VIEW (FOV): APPROX 20 DEG
- MECHANICALLY BORESIGHTED TO MULE
- CONTROL INTERFACE: LOCAL/REMOTE,
  NORM/FREEZE, FIELD/FRAME, RETICLE ON/OFF,
  HOT BLACK/WHITE, FOCUS IN/OUT, CONTRAST
  IN/OUT, BRIGHTNESS IN/OUT
LOW LIGHT LEVEL VIDEO CHARACTERISTICS

- SWITCHABLE SUPER-INTENSIFIED TV (S.I.T)
  GOAL: SURVEILLANCE WITH 1/4 MOON
- CCD ARRAY, 2/3 INCH FORMAT
  LINE RESOLUTION: 800 (COHU) OR 480 (PULNIX)
- ZOOM RATIO: 20:1
- COMPUTER GENERATED RETICLE
- REMOTE CONTROL OF ZOOM, FOCUS, BRIGHTNESS
  (AUTOMATIC IRIS IN NORMAL OPERATION)
- MECHANICALLY BORESIGHTED TO MULE
- CONTROL INTERFACE: POWER ON/OFF, ZOOM IN/OUT, FOCUS IN/OUT
ACOUSTICAL DETECTION SYSTEM CHARACTERISTICS

- SELECTABLE INFRASONIC AND ULTRASONIC FREQUENCY SHIFTING CAPABILITY
- SUPER-BINAURAL CONFIGURATION ANGLE AND PICKUP SEPARATION GREATER THAN HUMAN HEAD
- VARIABLE GAIN WITH CLIPPING
- INTEGRATABLE INTO TOV OPERATOR HELMET
- CONTROL INTERFACE: VOLUME UP/DOWN, SONIC ON/OFF, ULTRA ON/OFF, INFRA ON/OFF, BOOST HI/MED/OFF
LASER SAFETY IMPLICATIONS

IMPLICATIONS FOR DESIGN:
- POWER UP SEQUENCE
- ABORT/RECOVERY SEQUENCE
- COMPLEMENTARY TRIG/TRIGBAR SIGNAL PAIR

IMPLICATIONS FOR DEVELOPMENT PROGRAM:
- TEST LASER ONLY ON GUNNERY RANGE
  - COMPETE WITH USMC, HUNTERS, BISON
SURVEILLANCE SYSTEM WEIGHT BUDGET

FLIR 23.4
MULE 15.1
MULE SUPPORT 5.1
LLL VIDEO 18.5
ADS 3.0
TOTAL SENSORS 65
CABLE ASSEMBLIES 25
MOTION PLATFORM 98
TOTAL LIFT PAYLOAD 190
WEIGHT OF LIFT 470
TOTAL SURVEILLANCE SYSTEM 660 POUNDS
SURVEILLANCE SYSTEM POWER BUDGET

LIFT:
30 A @ 24 V PEAK
15 A @ 24 V AVERAGE
FAIL-SAFE BRAKE: HOLDS POSITION WITH ZERO POWER

PAN/TILT MOTION PLATFORM:
4A @ 24 V PEAK, < 0.5 A TYPICAL
< 0.05 A STANDBY

MULE:
RANGING MODE: 2 A @ 24 V
DESIGNATION MODE: 4 A @ 24 V AVG, 20 A PEAKS

FLIR:
16 A @ 24 V (PRIMARILY COOLING LOAD)
FIBER OPTIC COMMUNICATIONS LINK

- VIDEO
  2 CHANNELS, 6 MHZ B/W, 7 BIT ENCODING

- AUDIO
  2 CHANNELS, 18 KHZ B/W

- SERIAL DATA
  8 CHANNELS, 38.4 KBPS MAX

- 200 MBPS TOTAL
RV COMPUTER RESOURCES

- 3 PROCESSORS: RV, SURVEILLANCE, MULE
- MODIFIED STD BUS FORMAT (AIRBORNE CONNECTORS)
- CPU CARDS:
  WIN SYSTEMS SBC80C88
  32KB EPROM, 32 KB RAM
- MEMORY & I/O CARDS:
  1 MB RAM
  8 CHANNEL 12 BIT A/D
  8 CHANNEL 12 BIT D/A
  PARALLEL I/O: 32 BITS IN, 32 BITS OUT
CONCLUSIONS

- IT WORKS (SUCCESSFUL DEMONSTRATIONS)

- LESSONS LEARNED:
  - COMPUTERS ARE OUR FRIENDS
  - CABLELING CAN KILL YOU
  - ARCHITECTURE IS IMPORTANT
    (CONTROL/PROCESSING/COMMUNICATIONS)