Product Requirements and Specifications Document (PRSD)
GSM Remote Monitoring System

Approvals

Title	Print	Signature	Date

Revision History

Revision	Summary of Change	Originator
X.0	New Document	UTSA-ECE
X.1	- Updated Software/Hardware block diagrams, YOLO changed to TensorFlow Lite, and general grammar edits. - Updated the general constraints, Plans, Schedule requirement, Power requirement, Removed POE adapter, and the cost.	

Table of Contents

1. Introduction

This document contains the system requirements for GSM Remote Monitoring System. These requirements have been derived from several sources, including a brief listing of the most important sources.

1.1 Purpose of This Document

This document is intended to guide the development of the GSM **Remote Monitoring System**. It will go through several stages during the course of the project:

1. **Draft:** The first version, or draft version, is compiled after requirements have been discovered, recorded, classified, and prioritized.
2. **Proposed:** The draft document is then proposed as potential requirements specifications for the project. The proposed document should be reviewed by several parties, who may comment on any requirements and any priorities, either to agree, to disagree, or to identify missing requirements. Readers include end-users, developers, university faculty, course instructor, and any other stakeholders.
3. **Validated:** Once the various stakeholders have agreed to the requirements in the document, it is considered validated.
4. **Approved:** The validated document is accepted as an appropriate statement of requirements for the project. The developers then use the requirements document as a guide to implementation and to check the progress of the project as it develops.

1.3 Scope of the Product

Our current design will use a GSM monitoring system that detects valid alarms such as the motion of vehicles and humans. The system will use TensorFlow Lite which is implemented in a raspberry pi to analyze the video that is captured by a camera to detect the type of object. The system sends only valid alarms to the end user's cellphone.

1.4 Case for the Product (Need)

Currently, construction site managers utilize live/on-site security and/or fences and gates to prevent intrusion onto construction sites. The GSM Remote Monitor reduces the need for live personnel while still providing a high level of security. The system installation and setup are easy, it's a stand-alone product, and will have a DC-battery and solar panel to power it 24/7.

2. General Description

The Global System for Mobile (GSM) is a security system that alerts the user of potential illicit activity at sites that do not have any power or internet connectivity.

2.1 Product Perspective

The GSM Remote Monitoring System allows users to monitor an area without having to have personnel present on location. Stakeholders include the project

manager (project manager is the client who is running a project in the given location), the project manager's customer (project manager is creating a product for a customer) and subcontractors from whom the GSM monitoring system is sourced. The project manager's customer benefits from using the GSM Remote Monitoring System because not having security personnel drives down labor costs of the project manager, ultimately driving down cost to the downstream customer.

2.2 Product Functions

The GSM Remote Monitoring System monitors an area and sends messages to the product owner relaying the status of the area being monitored. Product functions include monitoring and communication.

2.3 User Characteristics

Prospective product users include construction project managers, loss prevention organizations and high security/access site managers. The general profile of prospective product users includes high school education with basic understanding of how to use cell phones. No other specialized skills are needed.

2.4 General Constraints

Product constraints include using an existing microcontroller (Raspberry Pi), camera, battery and solar panel. The constraints that negatively impacts the performance of the product is the battery – ideal situation would be for the new battery to be custom designed and built to sustain long periods of stand-alone charge (without needing charge from solar panel), and the GSM signal availability in the location of the system temporary/permanent location.

2.5 Assumptions and Dependencies

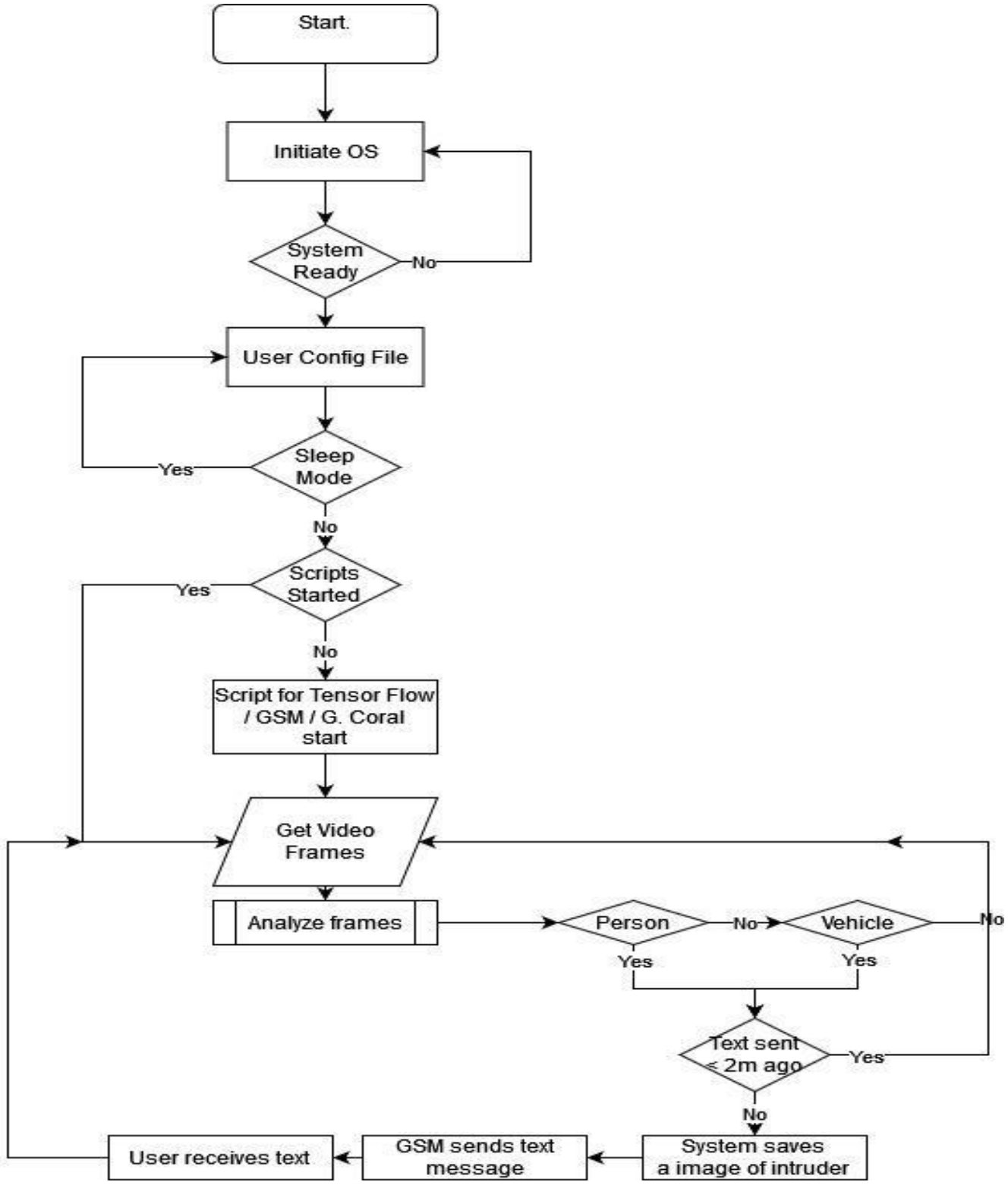
Product dependencies include access to satellite communications networks (existing satellites which are in use for general data transfer), continued production of cameras and microcontrollers (for future GSM Remote Monitoring production), and no shaded location of installation.

2.6 Objectives

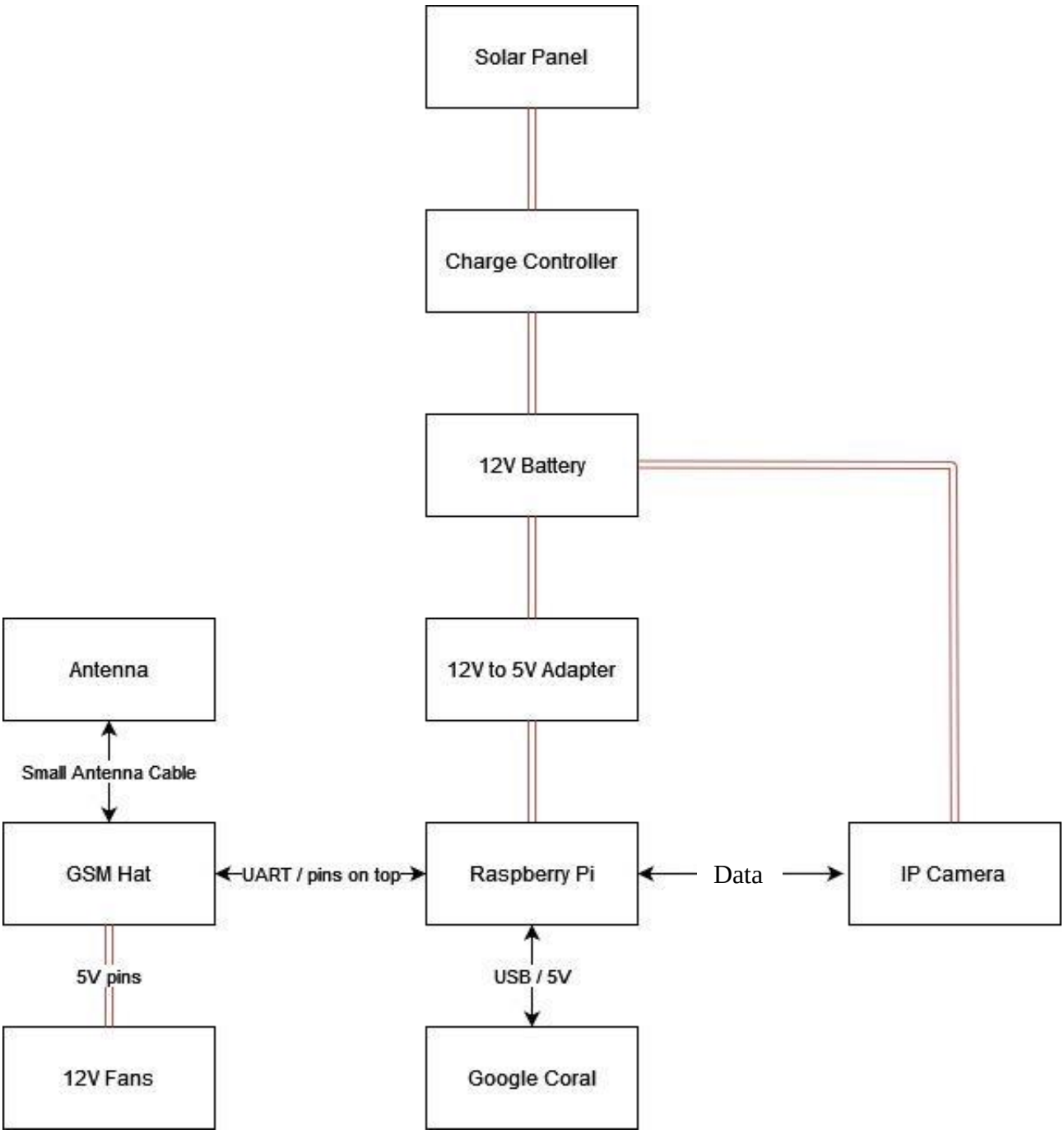
Technical objectives include

- Monitor area (video feed)
- Detect significant changes in the observed area (motion detection)
- Communicate changes in observed are to end user

- **Hardware Block Diagram**



- **Software Block Diagram**



2.7 Plan

- Decide all extra potential hardware components and source parts
- Learn more Python, OpenCV, and TensorFlow Lite
- Finish configuration of the GSM module on Raspberry Pi
- Install and run Google Coral for additional FPS on the final prototype
- Run extensive testing on the power supply system.
- Build the waterproof chassis to store all parts together efficiently
- Assemble all components in the final prototype
- Test and Modify (Iterative Process)
- Deliver final product

2.8 Schedule Requirements

Schedule is laid out in the Gantt chart below

Camera		Working on it		2021-08-19	2021-11-22	108.78
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency
	Purchase Camera	Done	100	2021-08-28	2021-08-31	
	Test IR/low light capabilites	Done	100	2021-09-01	2021-09-07	
	Test Tensor Flow with IR out side	Done	100	2021-09-07	2021-09-10	Implement tensorflow lite
	Test distance in outside	Done	100	2021-09-09	2021-09-10	
	Got the IP camera working	Done	100	2021-09-10	2021-09-10	
	Virtual bridge to IP camera	Done	100	2021-09-11	2021-09-13	
	Modify the Virtual bridge bash script	Working on it	0	2021-09-13	2021-09-25	
Device Housing		Working on it		2021-09-01	2021-11-22	20
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency
	Determine size of housing needed	Working on it		2021-09-01	2021-10-09	Purchase battery
	Heating cooling requirments	Done	100	2021-09-09	2021-10-17	Determine size of housing needed
	Make Housing	Working on it		2021-09-11	2021-10-09	
	Mock up of housing	Working on it		2021-09-14	2021-09-30	
	Purchase pipe for housing	Working on it		2021-09-14	2021-09-30	
Tensor Flow		Ready for review		2021-09-01	2021-11-22	
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency
	Get tensor flow working	Done	100	2021-09-01	2021-09-07	
	How to do a function call to if class==person/ve	Done	100	2021-09-02	2021-09-11	
User interface		Working on it		2021-08-30	2021-11-22	
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency
	Define user interface parameters	Working on it		2021-09-14	2021-09-23	
	input the cellphone number			2021-09-06	2021-11-22	
	Research node-red for automation			2021-09-01	2021-11-22	
	Research mqtt for app			2021-09-06	2021-11-22	
	Research WeMos					
				2021-08-01	2021-11-22	523.12

Raspberry Pi		Working on it		2021-08-31	2021-11-22	222.38	
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency	Completed For
	Purchase Raspberry Pi	Done	100	2021-08-31	2021-09-01		
	Implement tensorflow lite	Done	100	2021-09-01	2021-09-08		
	Purchase Google Coral	Done	100	2021-09-01	2021-09-09		
	Get google coral working	Done	100	2021-09-01	2021-09-07		
	Auto Start programs when turning on ras pi	On Hold	50	2021-09-06	2021-09-19		
	Use Raspberry pi without monitor attached	Done	100	2021-09-06	2021-09-08		
	Make a clone of raspberry pi os.	Working on it		2021-09-13	2021-09-26		
	3d print a raspberry pi housing (optional)						
GSM module		Working on it	High	2021-08-31	2021-11-22	80	
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency	Completed For
	Purchase GSM	Done	100	2021-08-28	2021-08-31		
	Use Library to send text	Done	100	2021-09-01	2021-09-10		Status Report 3
	Use library to recieve text messages	Working on it	0	2021-09-11	2021-09-18		
	Connect to Internet via GSM(optional)	Working on it	90	2021-09-10	2021-09-12		
	Write Script for GSM module	Working on it	0	2021-09-11	2021-09-19		
	Fix USB issues	Working on it	20	2021-09-13	2021-10-03		
	Virtual bridge to GSM			2021-09-14	2021-11-22		
	Modify Virtual Bridge Script						
	Test functionality			2021-09-01	2021-11-22		
	Remote to Raspberry Pi						
Power		Working on it	High	2021-08-01	2021-11-22	91.96	
Subitems	Name	Status	Percent	Timeline - Start	Timeline - End	Dependency	Completed For
	Determine power usage	Working on it	90	2021-09-01	2021-09-05		
	Purchase battery	Done	100	2021-09-06	2021-09-10	Determine power usage	
	Purchase Charge Controller.	Done	100	2021-09-07	2021-09-14		Status Report 3
	Purchase DC to DC converter	Done	100	2021-08-29	2021-09-01		
	Purchase Solar panel	Done	100	2021-09-09	2021-09-14		Status Report 3
	Test battery recharge with solar panel	Working on it		2021-09-14	2021-10-02	Purchase Solar panel	
	Test battery with 12V IP camera	Working on it	50	2021-09-10	2021-09-18		

3. Specific Requirements and Specifications

This section of the document lists specific requirements and specifications for GSM Remote Monitoring System Requirements and specifications are divided into the following sections:

- User requirements and specifications. These are requirements and specifications written from the point of view of end users, usually expressed in narrative form.
- System requirements and specifications. These are detailed requirements and specifications describing the functions the system must be capable of doing.
- Interface requirements and specifications. These are requirements and specifications about the user interface, which may be expressed as a list, as a narrative, or as images of screen mock-ups.

3.1 User Requirements and Specifications

1.1.1 User interface

The user interface is the user's cellular phone. The user can disable and enable the system by sending a text to the phone number that is associated with the SIM card that is used in the GSM module.

1.1.2 Ergonomics

The system will be assembled inside a plastic dustproof and waterproof enclosure with lock and size (8.6"x6.7"x4.3"). In addition to that, the solar panel will be mounted outside with an articulated arm to give the flexibility of adjustment for direct solar light.

1.1.3 Training or skills required

Technical understanding or experience working with the GSM Remote security system are necessary for the most efficient use of this system. Technical understanding of the components, lifetime of the battery, location that have visibility to direct solar light, within the area of coverage of the cellular provider are highly recommended to further increase the efficient use of this system in the field.

3.2 System Requirements and Specifications

3.2.1 Physical Characteristics

- Weight:	less than 15 lbs.
- Dimensions:	3' x 3' x 0.5'

3.2.2 Material Requirements

- Enclosure	ABS
- Articulate bracket	6061 aluminum alloy

3.2.3 Electrical Requirements

- Battery	12VDC, 9Ah
- Raspberry pi	5VDC, 1.2A
- IP Camera	12VDC, 0.1A
-Google Coral USB	5VDC, 0.5A
-Fans	12VDC, 0.06A

3.2.4 Abilities

- Camera
  - Wide angle
  - Has night-vision
  - RJ-45 connection
  - 12VDC
- Tensor Flow Lite
  - Analyze image
  - Accurate object type detection
- GSM Module
  - Compatible with 4G LTE networks in the United States
  - Compatible with Raspberry pi
- Solar Panels
  - Provide enough power to all components and charge the battery
  - Battery
  - Enough to keep the components to be powered for at least 15 hours
  - Google Coral USB
  - Process Neural network to increase TensorFlow Lite FPS

3.2.5 Limitations

- No GSM signal in the area
- No direct solar light

3.2.6 Equipment or materials required to use the product

- Raspberry pi
- 30 Watts 12V Solar Panel
- 20AH rechargeable battery
- GSM sim card with phone service plan
- Cell Phone

3.2.7 Equipment interface requirements

- Any phone that can receive and display text message

3.2.8 Handling and storage requirements

- Operating temperature 0°C to 40°C
- Storage temperature -25°C to 55°C

- Operating and storage humidity 5-85% non-condensing
- Battery is recommended to be disconnected

3.2.9 Cleaning and Sterilization

- The lens of the camera needs to be cleaned once every three months with a wet towel and then wiped with dried microfiber.
- Clean the solar panel with a wet towel and dry it up with a clean dried towel once every three months.

3.2.10 Product maintenance and serviceability

- An overall annual service is recommended to ensure all the wires remain intact and all the components are in good shape
- Replace the battery once a year

3.2.11 Operating Parameters

- Raspberry Pi 4
    - Power: 4.63VDC – 5.10VDC, 0.6A – 3.0A
    - Operating Temperature: -25°C to 70°C
- IP Camera
    - Power: 12VDC, 100mA
    - Operating Temperature: -30°C to 60°C

3.2.12 Repeatability and reproducibility

- The system is reusable with repeatable proper cleaning and maintenance of the components.

3.2.13 Reliability

- Depending on the GSM Signal and regular cleaning of the camera lens, and battery life cycle the system can function properly.

3.2.14 Mechanical safety features

- Components will be secured and properly mounted inside the enclosure to prevent component movement and mitigate damage during operation
- Solar panel will be secured with a mounting bracket attached to the enclosure
- Camera will be mounted to the bottom of the enclosure

3.2.15 Electrical safety features

- 18/2 wire will be used for power connection
- Cat6 cable will be used for the connection between the camera and processor

3.3 Interface Requirements and Specifications

The solar panel will be connected to the charge controller to avoid overcharging of the battery power and will be provided to the processor via a 12VDC to 5VDC adapter. The camera will draw power via USB. Google Coral attaches via USB. The processor sends text messages via the GSM module to the end user cellphone.

3.4 Environmental Conditions

3.4.1 Temperature

3.4.1.1 Operating: -25°C to 60°C
3.4.1.2 Storage: -25°C to 70°C

3.4.2 Humidity

3.4.2.1 Operating: 5-85% non-condensing
3.4.2.2 Storage: 5-85% non-condensing

3.4.3 Shipping, transportation vibration

- Foam-in-place systems will be used to provide all the protection of foam during shipping, warehousing, and general handling

3.4.4 Pressure and Altitude

-Maximum External Pressure: 1 atm.
-Maximum Altitude: 30km

3.4.5 Electromagnetic Interference

-less than 3 mT

3.4.6 Electrostatic Discharge

NA

3.4.7 Impact Resistance

NA

3.5 Manufacturing

3.5.1 Cost

- Raspberry Pi 4 8GB Extreme Kit - 128GB Edition (8GB RAM)	162.36
- Amcrest Ultra HD Outdoor IP Security Camera	108.78
- 30 Watt 12 Volt Polycrystalline Solar Panel	91.96
- Solar Panel Pole Mount Brackets Set Aluminum Mounting Brackets	49.99
- Duracell Ultra Rechargeable Battery 12V 9Ah	43.29
- Ogrmar ABS Plastic Dustproof Waterproof IP65 Junction Box	19.99
- 12V to 5V DC USB Type-C Right Angle Step-Down Power Converter	14.61
- GSM/GPS Module SIM7600A	80.99
- SIM CARD and annual service plan	66.00
- Misc wires and hardware	35.00
- Google Coral USB Accelerator	59.99
- Noctua Cooling Fans	20.00
- Chassis	25.00
	777.96

3.5.2 Environmental requirements for production

- Source, containment, and disposal of lithium-ion batteries.

3.5.3 Raw materials and suppliers

NA

3.5.4 Test methods, standards

- Install a prototype at a location with heavy traffic during the day and light traffic at night
- Testing the maximum system uptime on battery without connecting solar panel
- Testing the sending alert messages delay interval
- Monitor power consumption during a 5 day period to verify power supply suitability

3.6 Packaging

3.6.1 Packaging configurations

- About (3’ x 3’ x 0.5’) is the assembled system

3.6.2 Packaging materials

- Foam-in-place systems will be used to provide all the protection of foam during shipping, warehousing, and general handling.

3.6.3 Special shipment requirements

- Contains batteries and must be marked appropriately
- Contain fragile components and must be marked with handle with care

3.7 Labeling

3.7.1 Detail intended use, warning, directions for use, cleaning, expiration date

- Intention - on the enclosure “GSM Remote Monitoring System”
- Warning - on the package “Fragile, handle with care”
- Warning - on the package “Contain batteries”
- Warning - on the enclosure “Connect battery before use”
- Direction - inside the enclosure “Insert SIM Card here”
- Direction - inside the enclosure “Press to Turn ON”
- Cleaning - by the camera “Clean every three months”
- Cleaning - on the solar panel “Clean every three months”
- Expiration date – on the battery

3.7.2 Identify target audience for labeling

- End user, installer, service technicians

3.7.3 Language requirements
- English

3.8 Regulatory

3.8.1 Clinical trials
- NA

3.8.2 Submission type
- NA

3.8.3 CE mark
- NA

3.8.4 US and international standards
- The system assembly will abide by the guidelines of the following standards
  - ISO
  - IEEE-SA
  - OSHA

3.8.5 Patent issues
- Non-exact system have been found in the United States Patent and Trademark Office database

3.8.6 Existing technology to avoid
- None

4. Appendices

N/A

5. Glossary

TensorFlow Lite - is a neural net that is pre trained to identify objects/people
Raspberry Pi 4 - A micro controller/computer that will be the brains of the project
Python – Computer programming language
Open CV – Program that is coded in Python that allows the program to see using cameras
Google Coral – USB device designed to process neural networks to increase TensorFlow Lite FPS

6. References

List references and source documents, if any, in this section.

https://www.raspberrypi.org/documentation/hardware/raspberrypi/power/README.md

https://support.amcrest.com/hc/en-us/articles/360024404972-Power-Issues-When-Directly-Connecting-to-an-NVR-#:~:text=The%20power%20consumption%20of%20a%20single%20POE%2B%20camera%20is%20around,using%20the%20included%20power%20supply .

https://www.raspberrypi.org/documentation/faqs/

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7. Index

N/A