Senior Design Group 18
Aaron Cannon, David Adeola, Zheng Luo, Simeng Liu

Project Plan

Abstract

An automated system to track missing stop signs or other important warning signs (such as those related to containment areas or hazardous materials) removed by either perpetrators or due to severe weather conditions (hurricanes, tornadoes, winter storms, etc.) can be highly beneficial for transportation agencies. Such real-time monitoring of road and warning signs can significantly contribute to the overall safety of transportation and other utilities and save money and maintenance time by eliminating the need for visual inspection. The goals of this project are:
1. Develop a sensor-based (e.g., use of MEMS magnetic compass and an accelerometer to detect the rotation of the stop sign and the static tilt of the sign) tracking/monitoring prototype system that locates the whereabouts of critical warning/stop sign or damage sustained by a warning sign.
2. Develop a prototype wireless communications system in relation to goal #1 to communicate that information back to a central location (e.g., the Department of Transportation office)
Design constraints include delivering energy/power for the developed prototype, especially in remote locations, robust packaging to function in harsh environments, RFID signal interference with metal, etc.

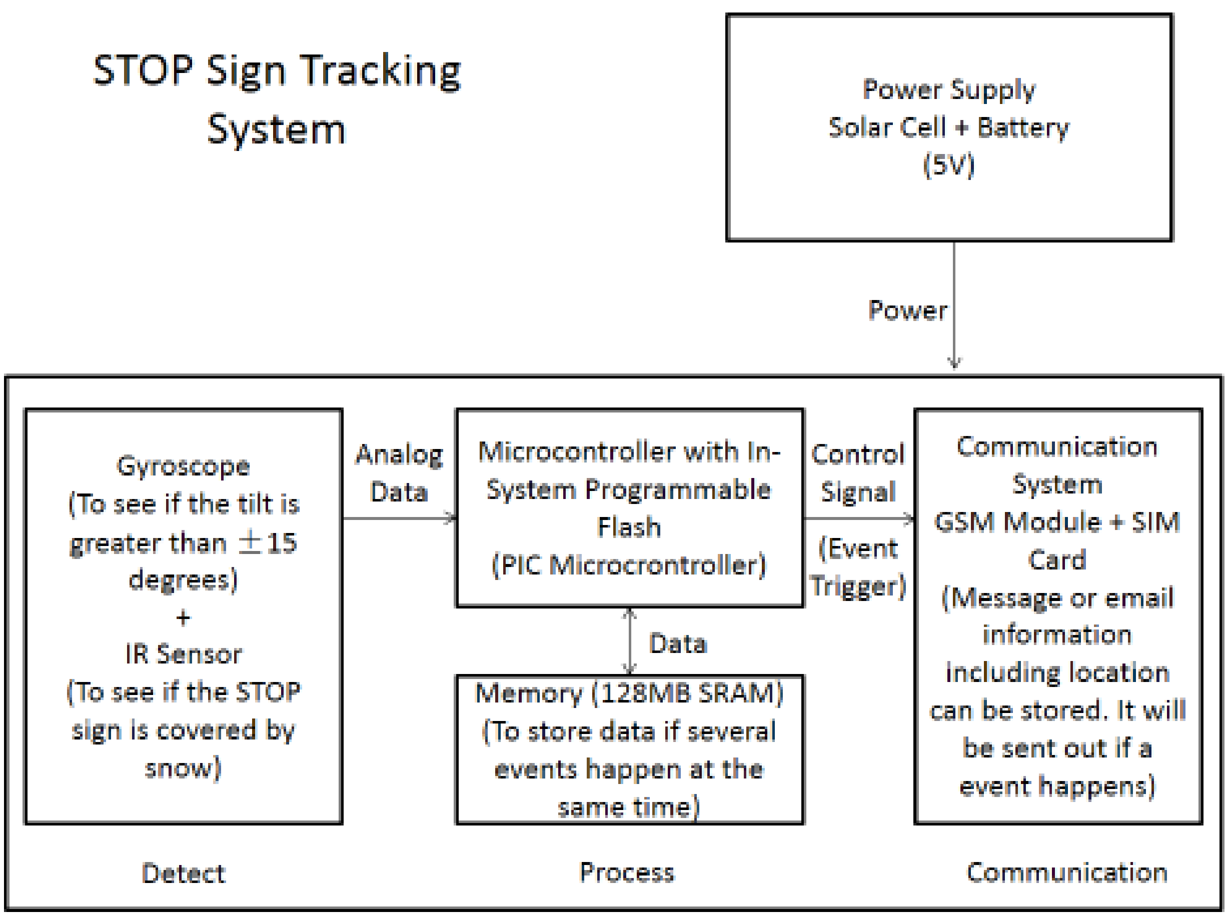
Purpose

The purpose of our senior design team is to develop a Critical STOP Sign Tracking and Monitoring Prototype System. We want the device to be data dependent so the sensor alerts us to the STOP signs status if it is tilting. We are design the device to have tilt threshold of 15 degrees. Once the sign tilt becomes greater than 15 degrees an alert should be sent out. Alerts will be event driven and only a message is sent out if an event occurs over a wireless communication to mobile devices. We expect a life cycle for 10 years. The design will withstand the Iowa weather throughout the year.

Functional Requirements:

Data dependent: The sensor should specifically figure out what happens to the STOP sign (whether it is covered by snow, or broken, or others).
Tilt threshold: Once the sign tilt becomes greater than 15 degrees an alert should be sent out
Send Alerts: Alerts should be event driven and only a message is sent out if an event occurs. Events are something that is being monitored that will render the sign non-functional or an incoming request for information.
Wireless Communication: Communication to mobile devices should be wireless to keep cost low
Self-Calibrate: System should calibrate itself to reduce maintenance and installation time
False-Positives: 10% of alerts can be false-positive alerts (alert sent out that sign broke constraints but constraints weren't actually broken)
False-Negatives: No false-negatives are allowed (No alert sent out event though constraints were broken)
Power Supply: System should be supplied 12V. Some of which will be used to directly supply system and the rest to be used to charge a rechargeable source.
Tracking: Should be able to locate the sign from the signal.

Non-functional Requirements:
Size: The package shouldn't be larger than 20% of the hardware being used.
Package: The system should be packaged with ESD materials that are weather resistant.
Weather Resistant: The package should operate in temperatures from -30 F to 120 F
-water-proof (rain, snow, fog…)
-wind resistant: should stay attached to sign under strong wind(~60MPH)
Cost-effective: The price for the package should be no more than $60.
// final figure TBD by client
Easy to Install: Installation onto stop sign should be no more than 10 minutes.
Lifetime: System should be able to sustain itself for 10 years



Senior Design Group 18
Aaron Cannon, David Adeola, Zheng Luo, Simeng Liu

Technical Risks

Risk	Probability of Going Wrong	Criticality (0 - 100)	Risk Factor	Mitigation Strategy
GSM module may not send the message if the signal is bad.	10%	95	95 * 0.1 = 9.5	To mitigate the issue, we will do our best to find a best carrier to be used in GSM module.
The solar system may not supply enough energy to whole package.	20%	80	80 * 0.2 = 16	We will test the solar system to find a best suitable one to supply power in our package.
Micro Controller may not handle the computation from the sensor	5%	100	100 * 0.05 = 5	We will test the micro controller to find a most suitable for compute all data.

Organizational Risks

Risk	Probability of Going Wrong	Criticality (0 - 100)	Risk Factor	Mitigation Strategy
The whole package may cost over our budget.	25%	60	0.25 * 60 = 15	Setting up a realistic budget from the start with extra wiggle room is the key. We will decide a cheapest combination of all components to test. If it doesn't work, we will try second cheap component.
There is not enough knowledge on programming the micro controller and sensors connection	10%	30	0.1 * 30 = 3	We are going to do some researches and find some tutorials. Also we will ask Dr. Daji for more coming problems.

Senior Design Group 18
Aaron Cannon, David Adeola, Zheng Luo, Simeng Liu

Cost Estimate

Item: Price: Link:

Communication System $30

http://www.sainsmart.com/siemens-tc35-sms-gsm-module-voice-adapter.html?___store=en&___store=en

Microcontroller $15

http://www.mouser.com/ProductDetail/SchmartBoard/710-0004-01/?qs=3AeMG6Kd7WlPu%2Fsj0WJe7A%3D%3D&gclid=CI75i9eyjboCFdFaMgodU2kAJw

Battery (9V) $10

http://www.digikey.com/product-search/en?mpart=LA522&vendor=547

Solar Cell $25
http://www.ecomelectronics.com/prodinfo.phtml?id=3268139&gclid=CJOZisef3bkCFe1DMgodAQUAFw

Gyroscope $13

https://www.sparkfun.com/products/10937?gclid=CNnc0tf3-rkCFYwWMgodIW0APw

Mounting Hardware $9

http://www.kjmagnetics.com/proddetail.asp?prod=MMR-A-XC

Enclosure $27
http://www.alliedelec.com/search/productdetail.aspx?sku=70159833&mkwid=EY6pEwsd&pcrid=18584042659&gclid=CNb0g-K1jboCFYhAMgodzRUAvg

Total $129