ICE & SNOW PREVENTION SYSTEM (ISPS)

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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Introduction

A problem with our current transportation system is the lack of protection from ice and snow build up. Our "Ice and Snow" prevention system is an autonomous entity that is dedicated to sensing and eradicating ice formations that often occur on bridges. The system our team has created uses temperature and moisture sensors in conjunction with a microcontroller to monitor and control the bridge's surface condition. With our system installed, drivers can be assured that driving across a bridge will be much safer.

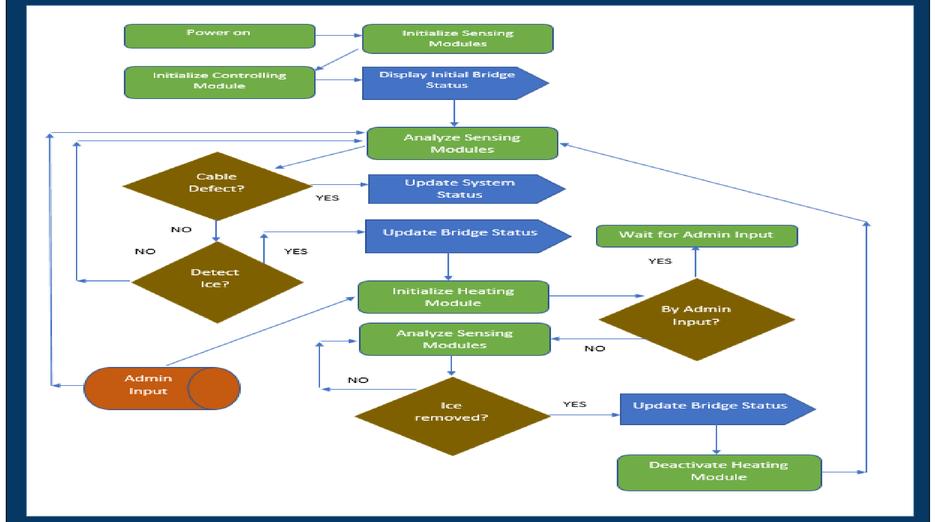
Objectives

- Detect conditions for ice formation on the bridge
- Heat bridge when ice formation is possible
- Provide updates of the bridge's condition
- Automatically detect the need for maintenance

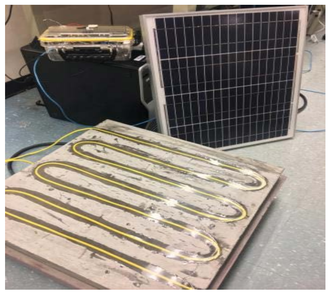
Engineering Requirements

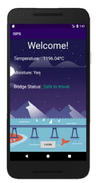
- The system must have a 90% or better ice detection rate
- The system must melt ice in half the time it melts naturally
- The system must informs consumers within a mile radius of the bridge's condition
- The system must be remotely controllable by an administrator
- The Ice Disposal System power consumption should not exceed 15 W/sq. ft.
- The system should be able to operate in temperatures as low as 5°F
- The system should automatically request for maintenance
- The system should maintain a 1' x 1' x .5' section of concrete
- The system width should not exceed 26ft.

System Behavioral Model



Design Prototype





Pin Name	Pin #	Pin #	Pin Name
IOREF	N/A	SCL1	SCL
RESET	N/A	SDA1	SDA
3V3	N/A	N/A	AREF
5V	N/A	N/A	GND
GND	N/A	13	D13
GND	N/A	12	D12
Vin	N/A	11	D11
Analog In 0	A0	10	D10
Analog In 1	A1	9	D9
Analog In 2	A2	8	D8
Analog In 3	A3	7	D7
Analog In 4	A4	6	D6
Analog In 5	A5	5	D5
VIN	VIN	4	D4
5V	5V	3	D3
3V	3V	2	D2
Analog Pin 7	A7	1	TXD
Analog Pin 11	A11	0	RXD
Digital Pin 50	D50		
Digital Pin 24	D22		
Digital Pin 41	D41		

VIN – 8VDC in from the power supply

5V – 5V pin to power sensing circuits

3V – 3V pin to power moisture circuit

I/O – Input/Output pins for sensing circuits, heater control, and error report.

Green Shading – Pins used by Ethernet shield.

Cement Construction

- Using type II Portland cement, 20% fly ash, and 5% fume silica by weight, we were able to simulate the Causeway bridge deck.
- The concrete passed multiple slump tests before the forming of the concrete slab was allowed to begin.

Results

- Can measure temperature with a tolerance range of +/-2.5°F.
- Can accurately detect whether there is moisture present or not.
- When simulating icy conditions with entire integrated system, heating element is activated and deactivated via relay switch in accordance with the sensors' measurements.
- Heating element can melt cubes of ice in a matter of minutes.
- MCU can transmit sensor and heating data to wireless app with very little delay.
- Using an infrared temperature gun, we found that the heating element that has been sealed into the cement can reach well over 115 °F within 5 minutes.
- Total wattage per square foot of the heating element is 44.29W/ft^2 producing a total BTU/hr output of 604.46 BTU/hr across the entire cement structure.
- Application displays measurements and heating updates correctly.
- Administrative manual controls operated as expected turning the heating element off and on at will.

COMPONENTS