SAFESEAT

ENGINEERING
COMPUTER SCIENCE PROJECT

Since 1998, on average, every ten days a child dies from hyperthermia after parents leave them behind in a car. SafeSeat is a proof-of-concept project to create a child carseat that alerts both parents and emergency responders in the event a child is left unattended in a hot vehicle. The project is built around a Raspberry Pi 3 with an Adafruit® FONA 808 shield.

1

Child buckled in carseat. Ignition key is turned to the "ON" position, reminder alarm beeps and green LED lights to notify user that the system is operational and the child is properly secured. System begins to monitor temperature.

2

The Raspberry Pi 3 along with the DHT11 temperature sensor monitor the internal temperature of the vehicle.

If internal temperature exceeds the preset threshold (37.8°C) or the temperature within the car increases by 8°C, emergency procedures are initiated.

3

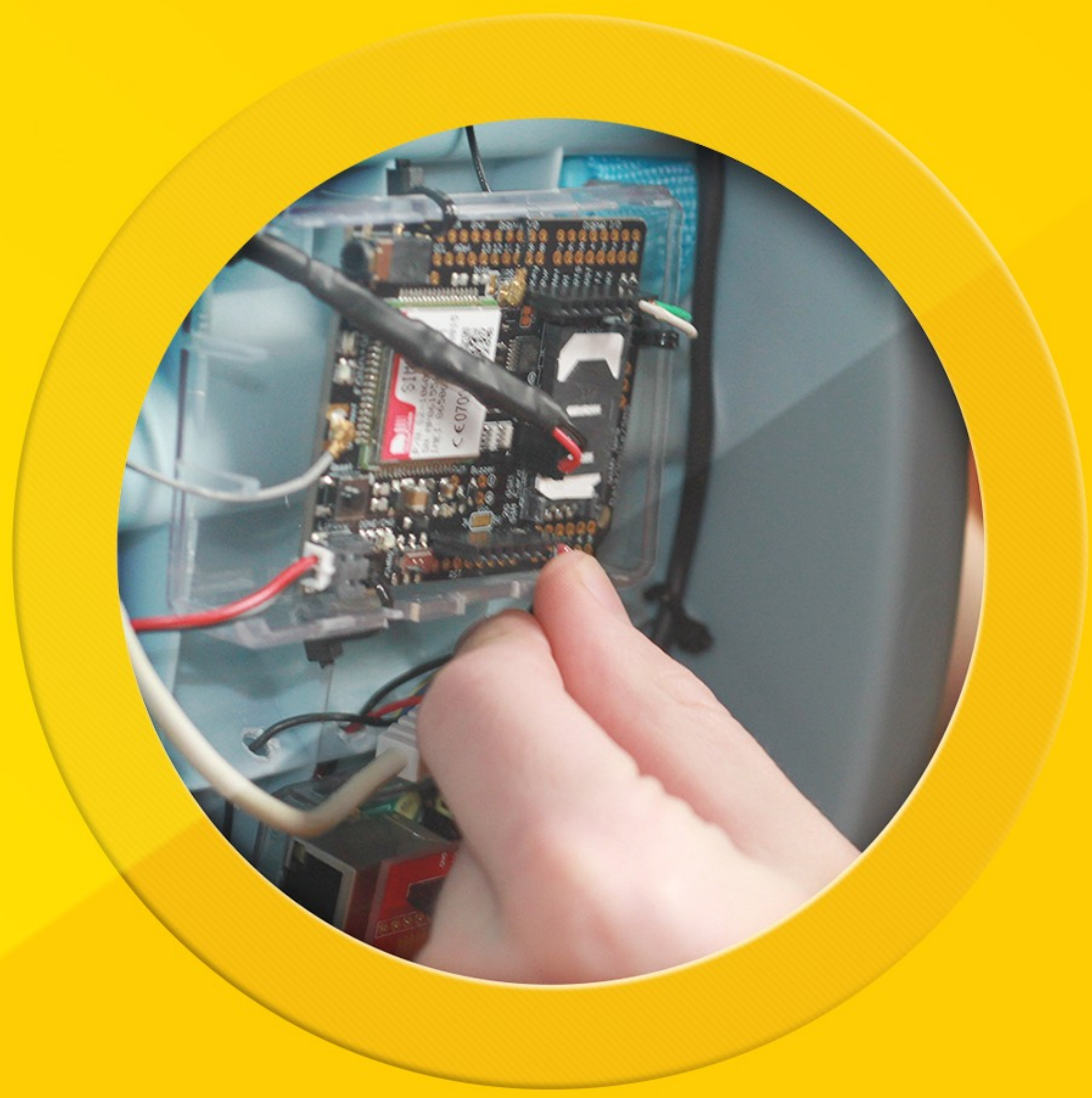
PRE-EMERGENCY PROCEDURES

When ignition is turned off, a triple beep alerts driver to the presence of a child in the carseat. If the child remains in the seat for more than 60 seconds, the system sends a cautionary SMS text reminder to each parent that a child is still in the vehicle.

4

LIFESAVING EMERGENCY PROCEDURES

A red LED warning light on the seat illuminates, audible alarm sounds to notify citizens nearby of the emergency. The vehicle's windows are lowered to dissipate the heat, an SMS alert notification with GPS location map is sent to each of the parents, a cell phone call to 911 emergency dispatch with a voice message that includes the precise GPS location of the vehicle is placed.

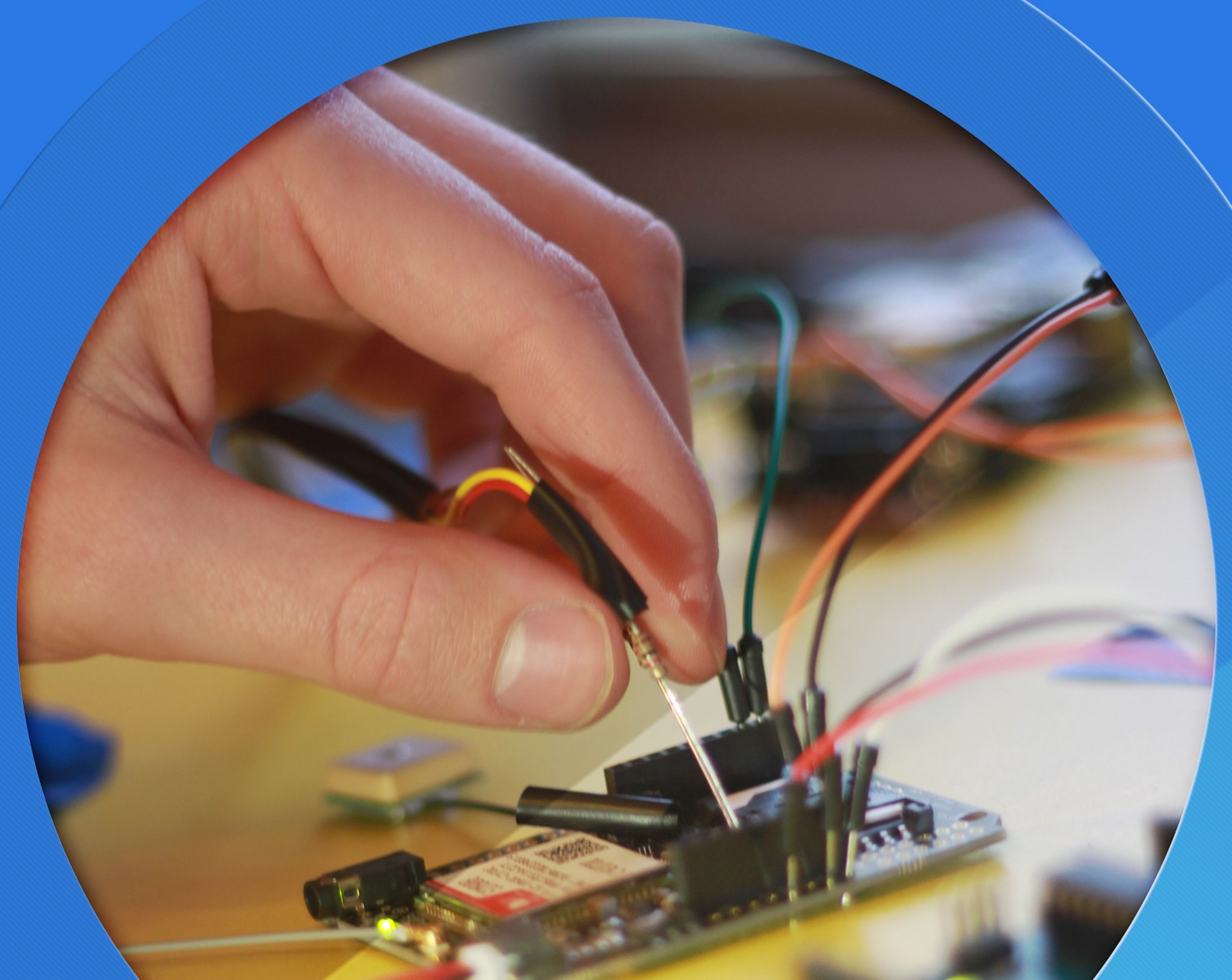


DESIGN CRITERIA

A Raspberry Pi will be used to monitor the risk of hyperthermia to children in an automobile. It will sense the presence of child buckled in a carseat. An on-board thermometer will constantly monitor the vehicle's internal temperature. If temperature exceeds a predetermined threshold, the system will sound an audible alarm, determine the vehicle's GPS coordinates, send an SMS message to both parents, voice call 911 emergency responders, and lower the vehicle's windows.

SUPPLIES

Raspberry Pi 3, ULN2003 driver, TinySine® prototyping shield, 28BYJ-48 step-motor, Adafruit® FONA 808 board, USB to TTL serial cable, GPS and GSM antennas, Anker® PowerCore 10000, SunFounder® active buzzer, monitor, keyboard and mouse, LED lights, and DHT11 temperature sensor, lithium ion polymer battery, child safety seat, resistors and capacitors, and soldering iron.



SunFounder Active Buzzer Sensor Module

Phantom YoYo DHT11 Analog Temperature & Humidity Sensor

SMAKN 28BYJ-48-5V 4 Phase 5 Wire DC 5V Gear Step Stepper Motor

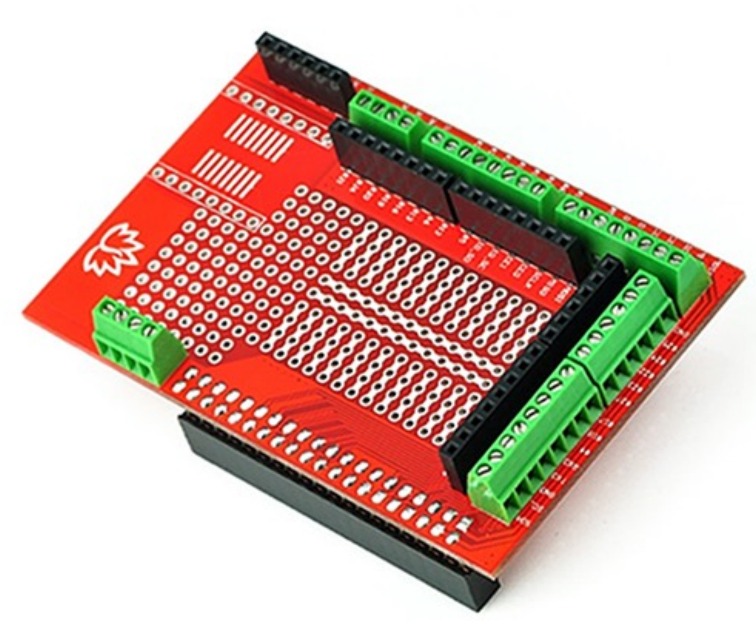
Blue PCB Board ULN2003 Driver Module

Adafruit Fona 808 Shield

- Cellular GSM + GPS
- Allows location-tracking, voice, text, SMS and data for SafeSeat

TinySine Prototyping Shield

- Breadboard and Perfboard connectors
- GPIO/I2C/SPI and power pins on the edges connect using screw-terminal blocks

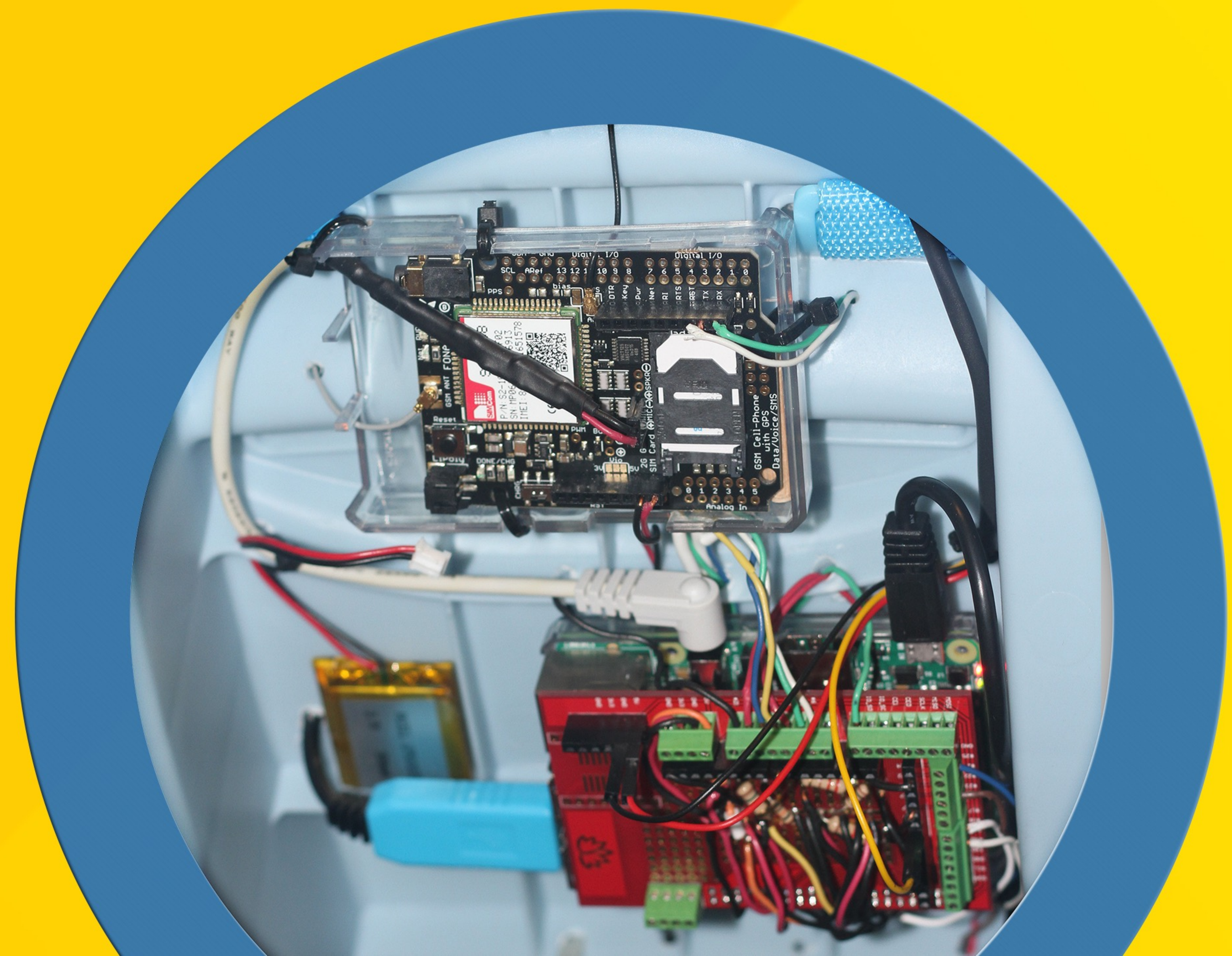


Raspberry Pi 3B

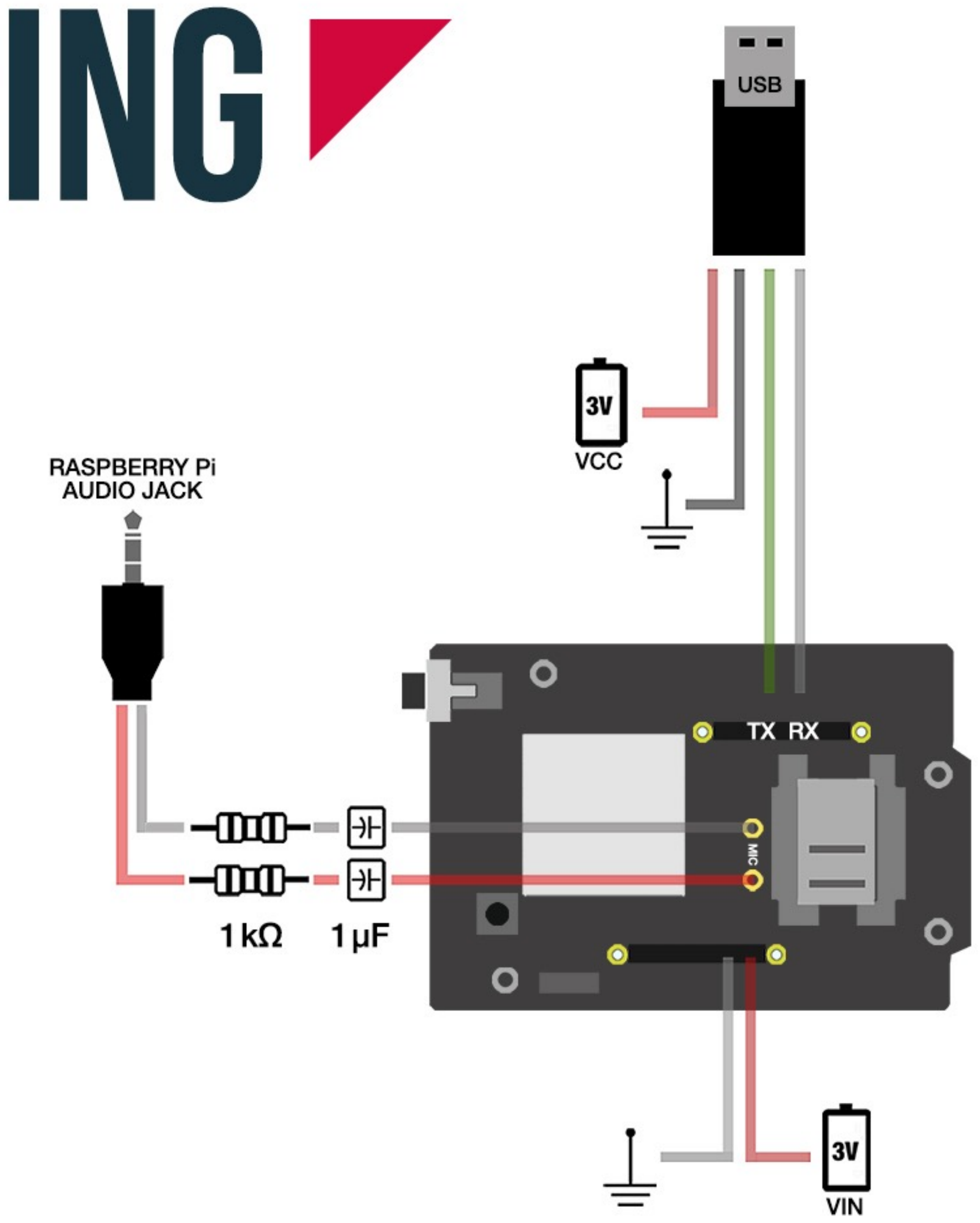
- 1.2 GHz 64/32-bit quad-core ARM Cortex-A53
- 17 GPIO Pins
- MicroSDHC On-board storage
- 1 GB LPDDR2 RAM

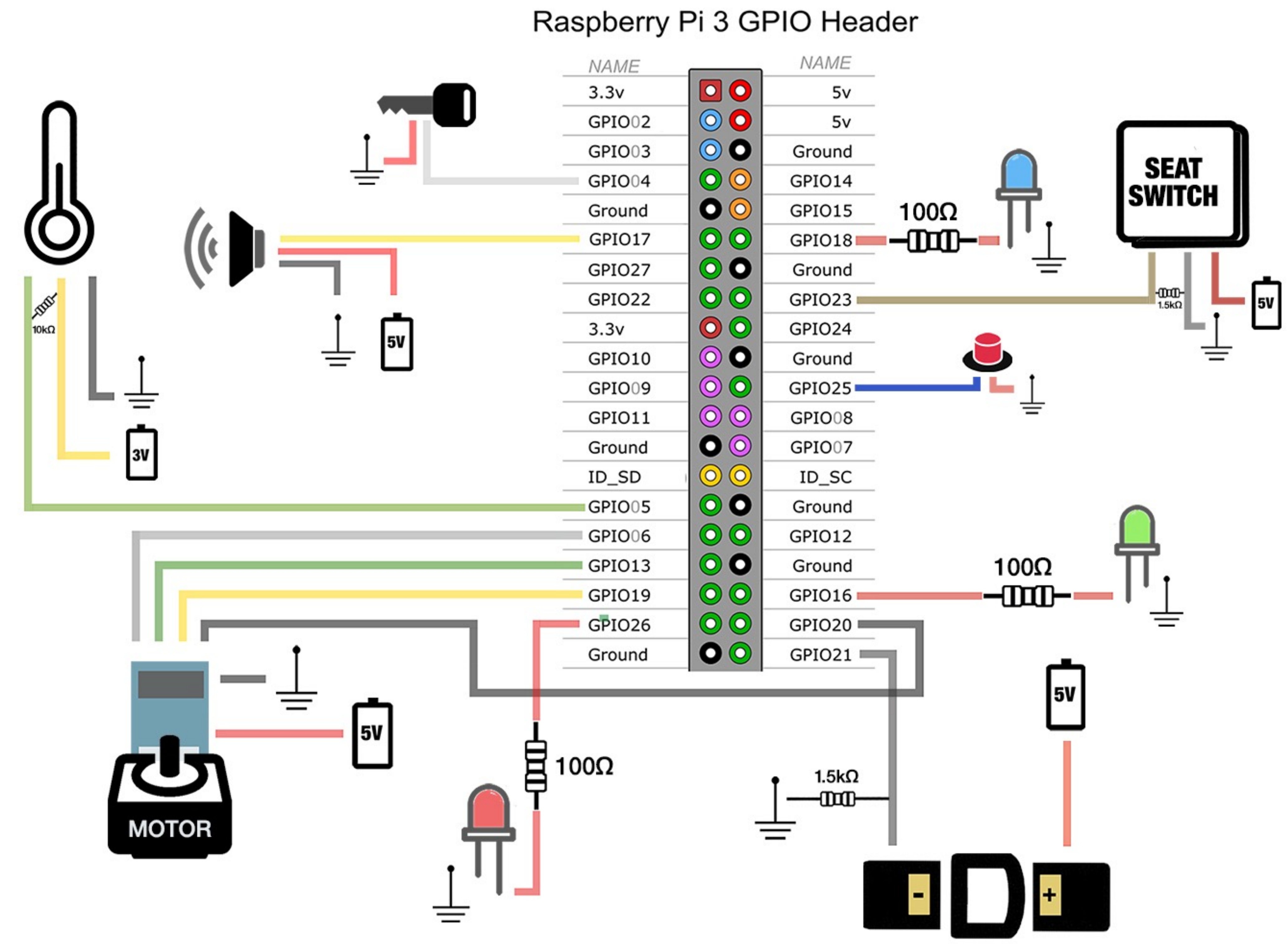
HARDWARE

The system is built around a Raspberry Pi 3 using the Python programming language. A TinySine® Prototyping shield is attached to the Raspberry Pi 3 GPIO pins. An Adafruit® FONA 808 board provides the interface for making phone calls, sending text messages, and obtaining GPS coordinates. It is connected using a Raspberry Pi USB port and a USB to TTL serial convertor. Other hardware inputs include a custom-built pressure sensor seat pad, a DHT11 temperature/humidity sensor, and a custom designed switch encompassed in the belt buckle. Other local outputs include a buzzer, a green LED, a red LED, and a 28BYJ-48 step-motor.



WIRING





A TinySine Prototyping shield is attached to the Raspberry Pi 3. An Adafruit FONA 808 board is connected using one of four Raspberry Pi USB ports by a USB to TTL serial convertor using serial communication.
Other hardware inputs include a custom pressure sensor seat pad, a DHT11 temperature/humidity sensor, and a custom switch encompassed in the carseat's belt buckle. The pressure pad has two wires, one attached to each metal plate of the pressure pad. One wire is connected to 5V power and the other secured to GPIO pin 23, and also to ground using a 1.5 kΩ resistor. The temperature sensor has three connections, DATA attached to GPIO 5, VCC connected to both 3.3V and DATA by a 10 kΩ resistor, and a wire attached to GROUND. The carseat's buckle switch consists of two wires attached by copper tape to the inside of the buckle. This is attached to GPIO 21 and joined to GROUND using a 1.5 kΩ resistor. The belt contains copper tape connected to 5V, which bridge the two wires when the buckle is secured, closing the circuit. Other local outputs include a buzzer, a green LED, a red LED, and a 28BYJ-48 step-motor. The buzzer connects to the Raspberry Pi with three wires, a wire connected to GROUND, a wire connected to 5V, and a wire connected to GPIO 17. The green and red LED lights are attached similarly. The LED cathodes are connected to GROUND; the green LED anode is attached to GPIO 16, and the red LED anode is attached to GPIO 26. The 28BYJ-48 step-motor is attached to a driver board which is used to turn the motor. The driver attaches to the Raspberry Pi using six wires, VCC 5V, GROUND, and four wires attached to GPIO pins 19, 13, 6, and 20.

IGNITION ON

IGNITION OFF

STORE CURRENT TEMPERATURE AND TIME

MONITOR SEAT BUCKLE & PRESSURE SENSOR

TURN ON GREEN LED - CHILD IS IN SEAT WITH BUCKLE FASTENED

SEAT BUCKLE UNFASTENED ALERT

CHILD IN SEAT ALERT

MONITOR TEMPERATURE

GREEN LED ON

TEMPERATURE INCREASES 8°C OR EXCEEDS 37.8°C

TEMPERATURE BELOW 37.8°C

TURN ON RED LED

SOUND SIREN ALARM

LOWER CAR WINDOWS

TEXT MESSAGE ALERT PARENTS

CALL 911

EMERGENCY ALERT MESSAGE WITH GPS COORDINATES

TIME SINCE IGNITION OFF > 60

PRE-EMERGENCY TEXT MESSAGE WARNING ALERT

TURN OFF OUTPUTS

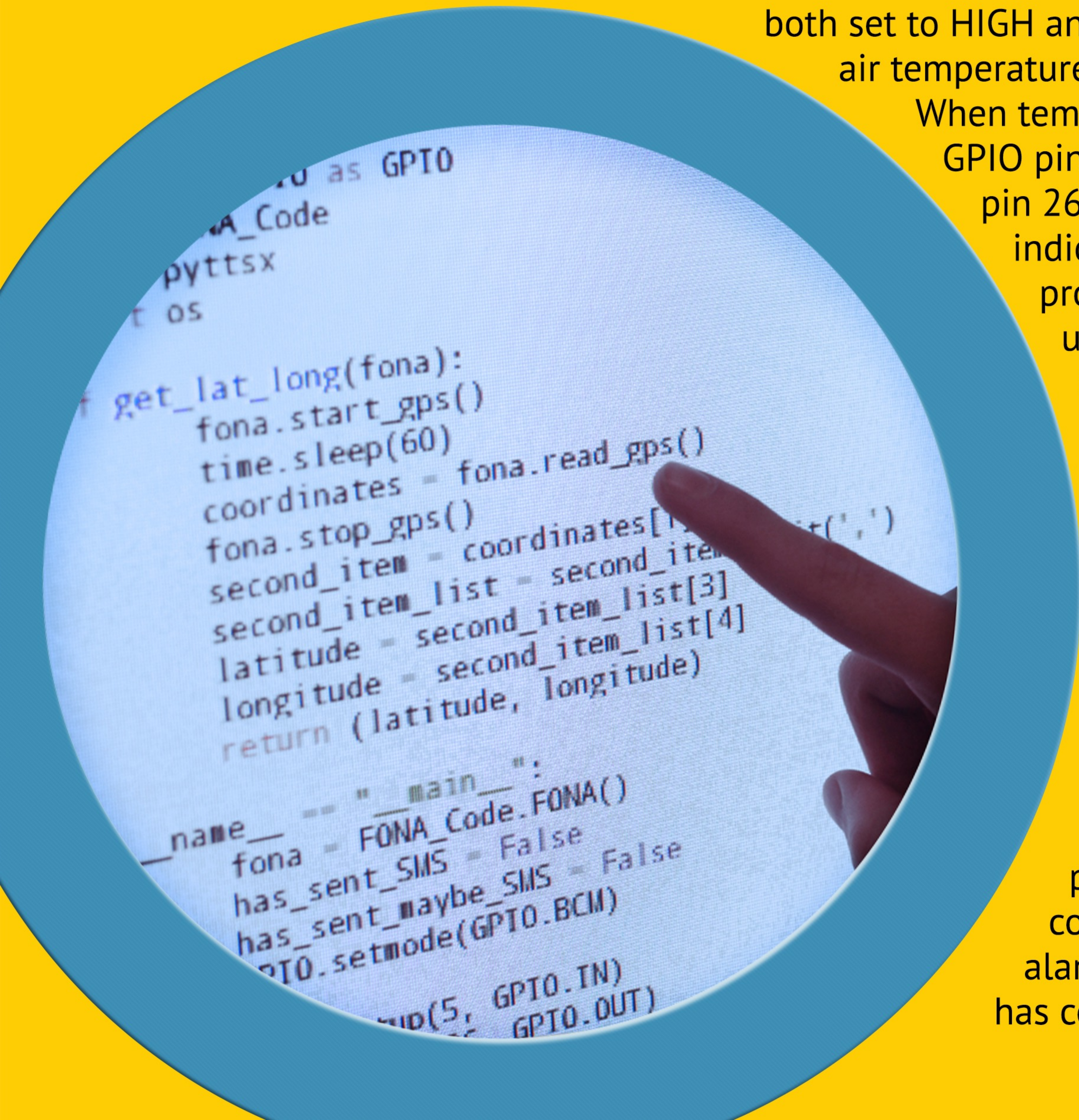
TRUE

FALSE

FLOWCHART

CODING

The main program enters the main function and begins an infinite loop. The output GPIO pins are set appropriately HIGH or LOW. The program enters a loop containing a conditional. If a child is not secured in the carseat or the buckle is not secured, the outputs are turned off and has_sent_SMS is set to False. If child is secured in the carseat, the pressure pad and seatbelt buckle are both set to HIGH and the system begins monitoring the surrounding air temperature. GPIO pin 16 is set HIGH to light a green LED. When temperature surpasses a predetermined threshold, GPIO pin 17 is set to LOW sounding the buzzer and GPIO pin 26 is set to HIGH, illuminating the red LED indicating emergency procedures are underway. The program lowers the window using a for loop, seq, using the variable, steps. A FONA 808 board obtains GPS coordinates. The function get_lat_long uses fona.read_gps to pinpoint the GPS coordinates. After acquiring the GPS location, a SMS text message is sent to the parents of the child using the FONA class. The alert notification contains a URL to Google Maps with a drop pin of the current car location. Emergency responders are called using the function fona.call_911. os.system command uses text-to-speech software, to read a stored message to the 911 operator and provides GPS location of the vehicle. System continues to monitor temperature and sound the alarm until the internal temperature of the vehicle has cooled beneath the predetermined threshold.



THOUGHTS

The goal of this project was to aid in the prevention of hyperthermia deaths of children left in vehicles. By using a Raspberry Pi 3, a carseat was created to detect the threat of hyperthermia. Alerting the nearby public by sounding an alarm and notifying the child's parents and emergency responders with the vehicle's GPS coordinate, the chances of rescue are increased significantly. Once the likelihood of hyperthermia is determined, the vehicle's windows are lowered to allow trapped heat to dissipate.

THE FUTURE

Further development may use the accelerometer to control the functions of individual sensors and a smartphone application to remotely deactivate the system and allow Bluetooth support of emergency alert notification settings.

THANK YOU.

I LOOK FORWARD TO SHOWING YOU THIS EXCITING PROJECT.