Technical Answers to Real World Problems (TARP)

Final Report- SMART Life Jacket

Submitted by –

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Literature Survey

RADIO FREQUENCY:

Paper [9] – The author discusses about the possibility of RF Communication via Arduino. This communication is done at 433MHz. This is good for communication of over 300-500m. For higher distance communications factors like transmitter power, receiver quality, type, size, and height of antenna, mode of transmission, noise, and interfering signals come into picture.
Paper [10] – This paper provides us with an example use case of the RF transmission. Here a generator system is controlled by a RF module. This is can be used in our case by using this method to switch on off the SOS sound alert on the lifejackets.
Paper [12] – The proposed drowning rescue system in this paper aims to curb deaths from drowning by observing the rise and fall of the heart rate and blood pressure of a swimmer or non-swimmer in water using a heart rate pressure sensor and if endangered, sends signals from the wearable device attached to the wrist of the victim who maybe undergoing a near drowning experience using a 433MHZ transmitter to the 433MHZ receiver or rescuer who could be a lifeguard, parent or neighbour, in order to enable the rescuer render immediate help.

INTEGRATION OF GSM AND GPS WITH ARDUNIO:

Paper [4] – This paper deals with the part of our project topic of interfacing of GSM and GPS modules. There is an assortment of regions wherein a need exists for a framework equipped for distinguishing and following the geographic area of a far-off vehicle, which requires steady reconnaissance of the vehicle. This framework comprises of Global Positioning System (GPS) and GSM. GPS and GSM together decide the area of the vehicle. This framework contains single-board inserted framework that is furnished with GPS and GSM modems alongside Microcontroller that is introduced in the vehicle. During vehicle movement, its area can be accounted for by SMS message. The reason for this framework is to plan and incorporate another framework which is coordinated with GPS-GSM to give following component: a) Location data, b) Real time following utilizing SMS, c) Track the vehicle driver movement d) Communication is prompt consequently we can get running report rapidly.
Paper [5] – This paper is all about tracking a vehicle in land which was involved in accident. The progression in innovation has expanded the perils in rush hour gridlock and street mishaps occurring much of the time causes death toll and property this is because of absence of crisis and help offices. This paper gives an answer for this disservice. At the point when a mishap happens quickly the vibration sensor recognizes the effect and miniature electro mechanical framework (MEMS) will identify this flag and send it to Arduino TDGGSM_908 microcontroller. The microcontroller starts GPS, follows the mishap area and sends a ready SMS utilizing GSM to the police and clinical salvage group. In the event that the effect of the mishap is not exactly the normal determined effect which makes danger human lives then the ready SMS would not be sent.
Paper [8] – This paper discusses about combination of GPS and GSM to make a tracking system. GPS is a satellite-based navigation technology that provides accurate location and information. The GSM module is used to transmit and receive an update from the object

location to a database Arduino is linked to the GPS and the GSM module in the serial connection. The GPS receiver sends data to Arduino. Then, Arduino instructs the GSM module to send the location data to the GSM enable device in a short message form. Thus, by using the tracking system, it is easy to calculate and get the estimate location.

Paper [7] – This paper focusses on passive Vehicle tracking using GPS module in Arduino. This is done using GPS technology, Arduino embedded system, Arduino IDE open-source software, SD card, MATLAB and Google Maps API. The library used for this is TinyGPS++, MemoryFree, SDFat libraries.

USAGE OF GPS AND GSM IN MARINE SURFACE:

Paper [1] – The main concern in this paper is to propose a smart jacket that has an inbuilt GPS tracking feature. The jacket in this paper has an inflation unit along with GSM and GPS modules. When an accident occurs, then the salt kept in the device get dissolved in water and make the co2 cylinder valve open. Then the gas gets filled the inflating unit and thus the floating occurs. This helps the user to float in water. This activity activates the GPS module and the exact location of the victim is sent to the rescue department via GSM module, thereby making the recue process fast and more efficient.

Paper [6] – This publication has the significant impact on our project topic which is finding a person on the marine terrain and sending the persons location to the nearby people. In this they are interfacing Arduino with Pulse sensor and GPS module and also the IoT part is involved to transport the location from the victim to the rescue team.

UNDER WATER COMMUNICATION SYSTEM:

Paper [13] – The entire system mentioned in this paper consists of drowning detection enabled goggles and an alarm receiver. The alarms from goggles are transmitted under water through existing under water communication technology like acoustic waves, infrared etc. The selection of communication technology is crucial from the range perspective. The bottom portion of the alarm receiver is immersed underwater and top portion faces outside water. The bottom portion receivers pick the alarms transmitted from the victim’s goggles. These alarms are further processed and transmitted to life guard or concerned authority wired or wireless, depending on the need

Project Description-

The proposed project aims to provide a solution to increasing deaths due to drowning. One of the reasons of increasing life loss is, sometimes rescue team fails to locate the victim in proper time and the person dies. In order to minimise the rescue procedures and increase the security of the users, we aim to propose this project which has additional features in the normal life jacket to track drowning people’s location as soon as possible, in order to his save life.

There are 2 major parts of the project –

i) Detecting the danger and capturing location of user.
ii) Transmitting the location of the person and getting help for him.

The system is activated when a person is in water. This is the initial trigger for the second part of the circuit.

The location data of the victim is tracked by using GPS module and SOS signals will be sent using RF Transmitter which will contain the GPS coordinates which will be used to trace the victim's accurate location. Receiver Circuit receives the data and Rescue team acts accordingly.

Proposed Components –

1. Water sensor
Input voltage: 5V/3.3V
Current: <20ma
Interface: Analog signal
Water sensor is used to detect the presence of water on the surface of the sensor. It detects the water by measuring the water's electrical conductivity. Water sensors are mainly used to ward off the flow of water in case any leakage happens, thus informing the entire circuit by sending a signal of the water presence. We are using a water sensor to detect the presence of water around the life jacket. If the water sensor gives a positive output, this means that the life jacket is in water and the user needs help.

2. Arduino MEGA 2560
Operating voltage = 5 V
Input voltage (limit) = 6 – 20 V
Current = 20mA per I/O pin
Pins: 54 (digital) + 16 (analog)
Serial ports: 4
The Arduino MEGA 2560 is an opensource microcontroller board based on the Microchip ATmega2560 micro controller and developed by Arduino.cc. The board is equipped with sets of digital and analogue input/output pins that may be interfaced to various expansion boards and other circuits. Arduino IDE is used to program MEGA. Arduino is the main processing unit of the project, it inputs the data water sensor, checks the conditions, and it can be dangerous, it activates the transmitter to send data to the base station. Arduino is also connected to a GPS module, thought which it sends to the location of the victim through RF.

3. Transmitter

Frequency Range: 433.92MHz

Input Voltage: 3-12 V

The RF Transmitter Module consists of 4 – pins: VCC, GND, Data and Antenna. VCC and GND pins are connected to 5V and ground respectively. The data pin is connected to any of the digital input / output pin of the Arduino. The antenna pin must be connected to an antenna which is nothing but a wire wound in the form of a coil. This will be used to send GPS location and heart-rate sensor information to the rescue station. The model may vary depending on the range required.

4. Receiver

Frequency Range: 433.92 MHz

Modulation: ASK

Input Voltage: 5V

The RF Receiver Module consists of 4 – pins: VCC, GND, Data and Antenna. VCC and GND pins are connected to 3.3V pin of the Arduino and ground respectively. An antenna similar to the transmitter module is connected to the antenna pin of the 434 MHz Receiver module. It will be placed at the rescue station which will receive the said GPS coordinates and heart-rate. So, the rescue team can respond to this SOS signal.

5. GPS Module (NEO-6M GPS Module)

Interface: RS232 TTL

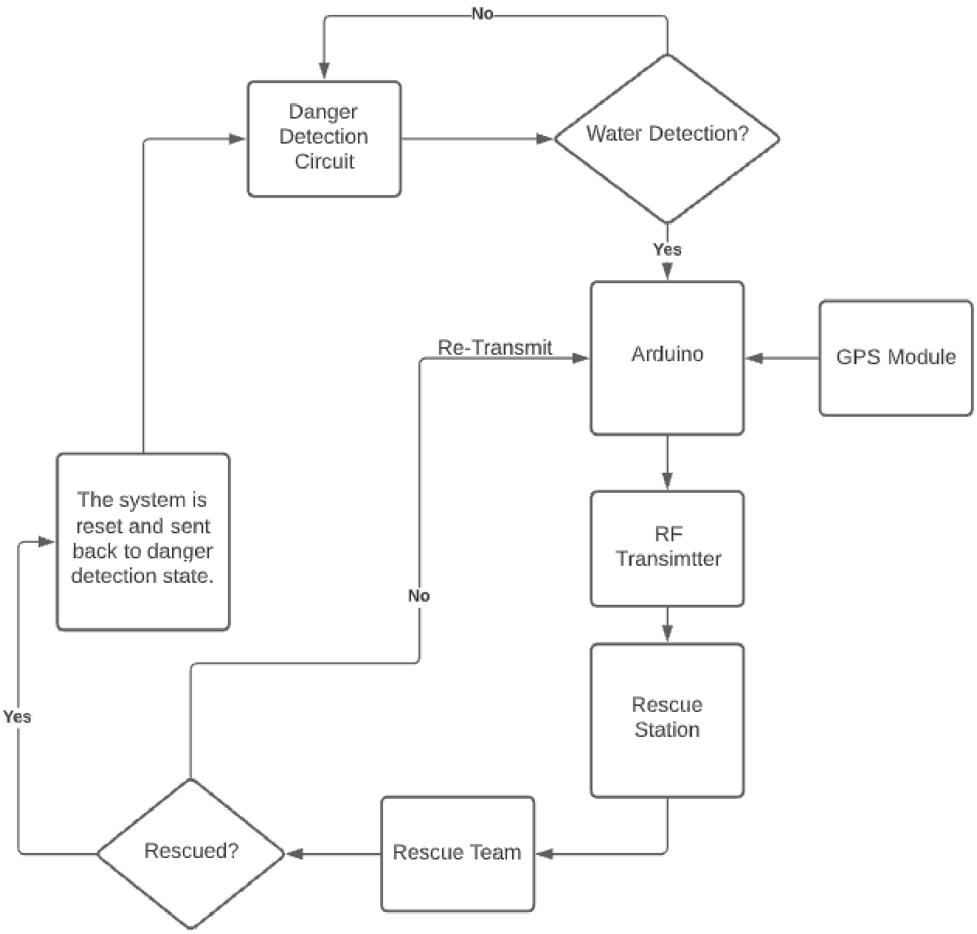
Power supply:3V to 5V

Default Baud Rate: 9600bps

The NEO-6M GPS module has four pins: VCC, RX, TX, and GND. The module communicates with the Arduino via serial communication using the TX and RX pins. TX and RX cross connection is done between the Arduino and GPS module. This is used to get the latitude and longitude of the device and send it to Arduino. Which further can be transmitted through the transmitter and get the rescue team for help.

Methodology

The flowchart below explains the whole working of the Smart jacket. Arduino checks for the presence of water and sends an alert to the rescue team in the form of SOS signals through the RF Transmitter. A GPS module is also added in Arduino, and the location data is sent to the rescue team. Based-on the data received, the team tries to locate the victim. To make the tracking system more efficient, additional buzzer functionality is added to it. But it is a future modification and will not be a focus in this project



The whole system can be divided into 3 major parts-

1. Danger Detection
2. Transmission - Reception of Victim's Data
3. Location Tracking and Rescue

Danger Detection -

The main aim of this Smart Life Jacket is to detect when the user is drowning and needs help. In this system we check for the presence of water, as a parameter to detect danger (a heart-beat sensor can be added to communicate the status of the user, but it is a future modification and will not be a focus in this project). A GPS module is used to send the exact location of the victim at the time of drowning or just stranded at a waterbody. Water sensor is used to detect the presence of water around the user. If water is detected, positive input is given to Arduino. The system checks the value of the water sensor attached to the life jacket. If the water sensor detects water around the user, the circuit will be activated. The GPS location data of the drowning victim will now be processed by Arduino.

Transmission - Reception of Victim's Data –

Once danger is detected, the rescue team must be alerted about the drowning in order to save the victim. Once the circuit activates, it transmits SOS signals, via RF transmitter, at the frequency of 443 MHz The SOS stands for "Save Our Ship". It is an emergency signal which will be sent at the given frequency. These SOS signals contain the data from the GPS module and heart beat count of the victim. Once the signal is sent then the rescue team, they can take the required actions to track and save the victim.

Location Tracking and Rescue –

The Rescue team uses GPS data received to locate the victim. But there are some limitations to this. The data of the location might not be very precise, due to which the team might have some difficulties to locate the victim accurately. To overcome this drawback, a buzzer is attached to the jacket which will start ringing when the rescue team is within 50 feet of the range from the victim. This will help the team to find the victim even in dark, in minimum time and save his life. The overall power consumption of our model is low as the sensors require very less power. And battery life is high, thus making the system fit for use.

Project Analysis -

In this project, we will develop software simulation if the whole system. Steps we took so far to execute the model are –

Components Selection:

We went through several research papers and decided on the best possible components, that will make the system more effective and feasible.

- Heart rate Sensor* and Water sensor – For danger detection
- GPS module – For location tracking
- RF Transmitter and Receiver – For data transfer using SOS signals
- Arduino MEGA – Edge device for data processing and trigger detection.

*mentioned here but omitted from project due to library file errors

- **Software Selection:**
  We chose Proteus 8 software for simulation. We tried to find the required components on other platforms like TinkerCAD and Cisco Packet Tracker, but sensor components weren't available.

- **Danger Detection Circuit:**
  Proteus does not have Heart rate (pulse)and Water sensor inbuilt, external libraries we were added to it.

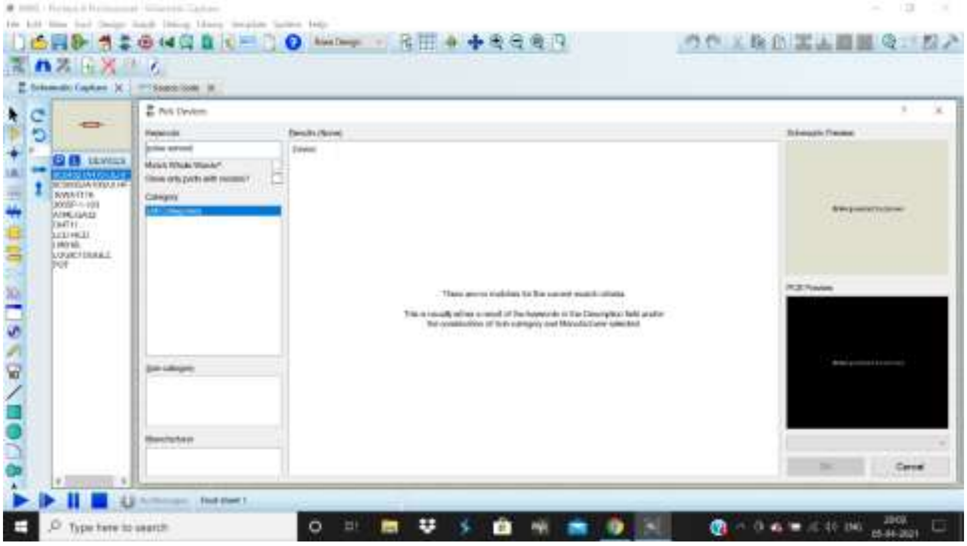


Figure - Pulse sensor not found in Proteus

Heartrate Sensor Library - https://www.theengineeringprojects.com/2017/09/heart-beat-sensor-library-proteus.html
Water sensor Library – https://www.theengineeringprojects.com/2020/07/water-sensor-library-for-proteus.html
Circuit –

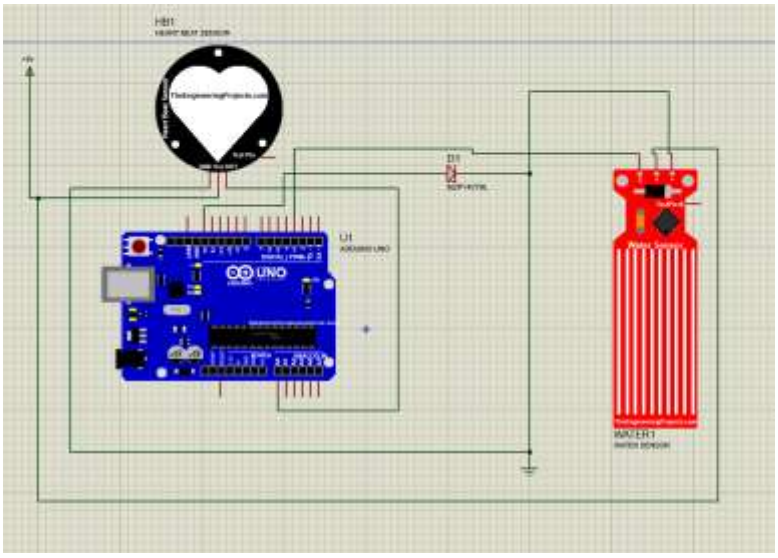


Figure – Initial Danger DetectionCircuit in Proteus

Status –
The Code for capturing and continuous monitoring of both the sensor values if written in Arduino IDE. The code compiles and proteus.
Due to some in-built file error in library files of heart-beat sensor, the heart-beat sensor doesn't work in proteus hence hindering the water sensor. Hence the Heart-rate sensor has been removed and only water sensor is implemented

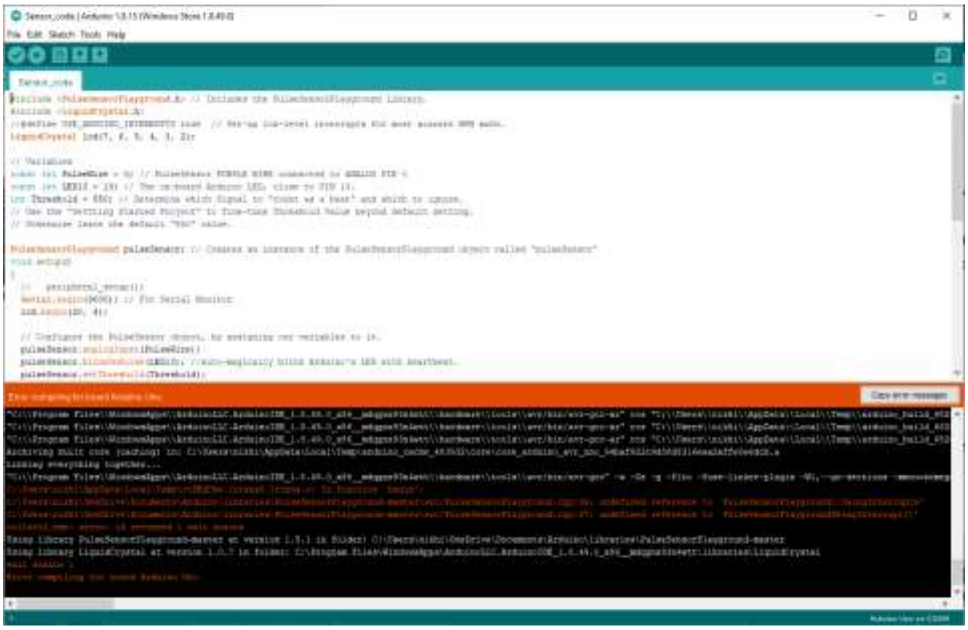


Figure – Error in the Danger Detection Code

- **GPS module Circuit:**

  An extra Library for GPS module was required. (Tiny GPS)

  The Code for GPS module was written in IDE and the file is added successfully in proteus, it required some data processing to make increase data legibility.

  Circuit –

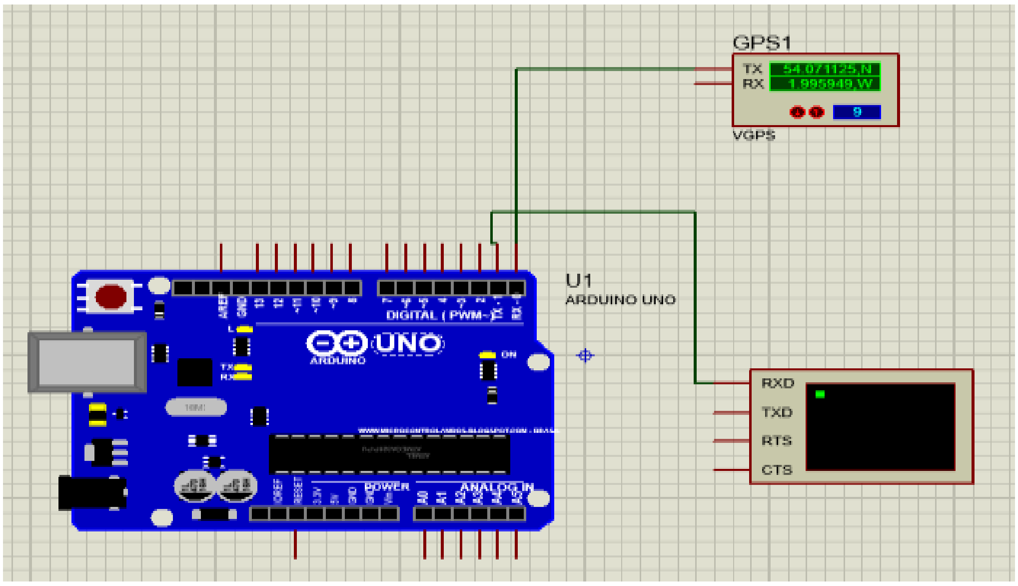


Figure -GPS component connections

Status –

The GPS module works individually. Now an additional function has to be added in the code as a whole for GPS module. Integration part is remaining.

- **Transmitter and Receiver Circuit:**
  Additional Library for Transmitter and Receiver module was not required.
  Code has been written in IDE and it works on proteus. Transmission is done using SOS signals at a frequency of 433.92 MHz.
  Screenshots showing the Transmission and Receiving of various types of data

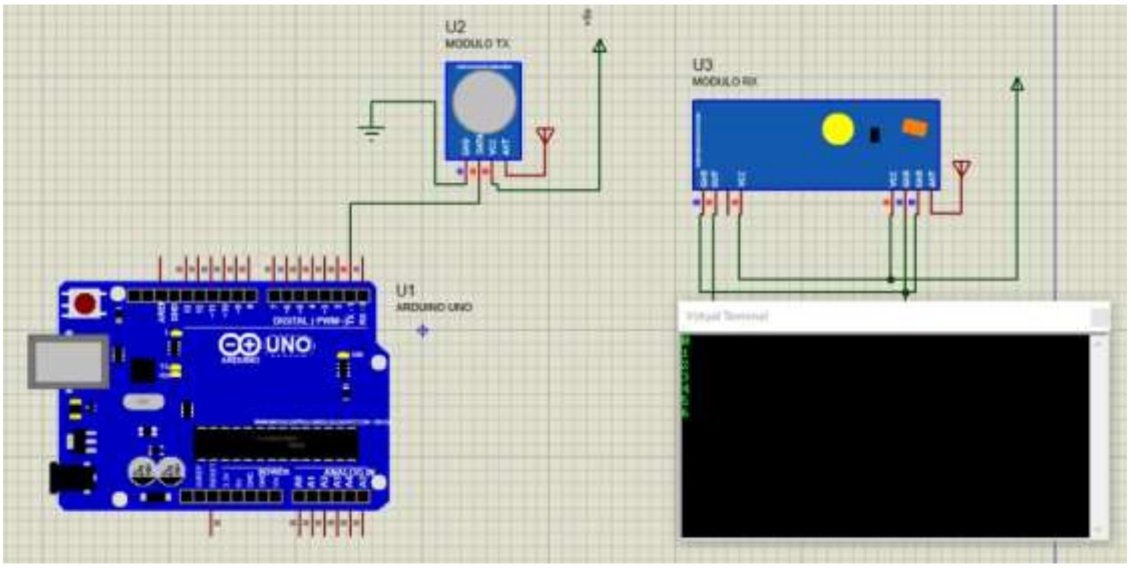


Figure - transmission of integral numbers

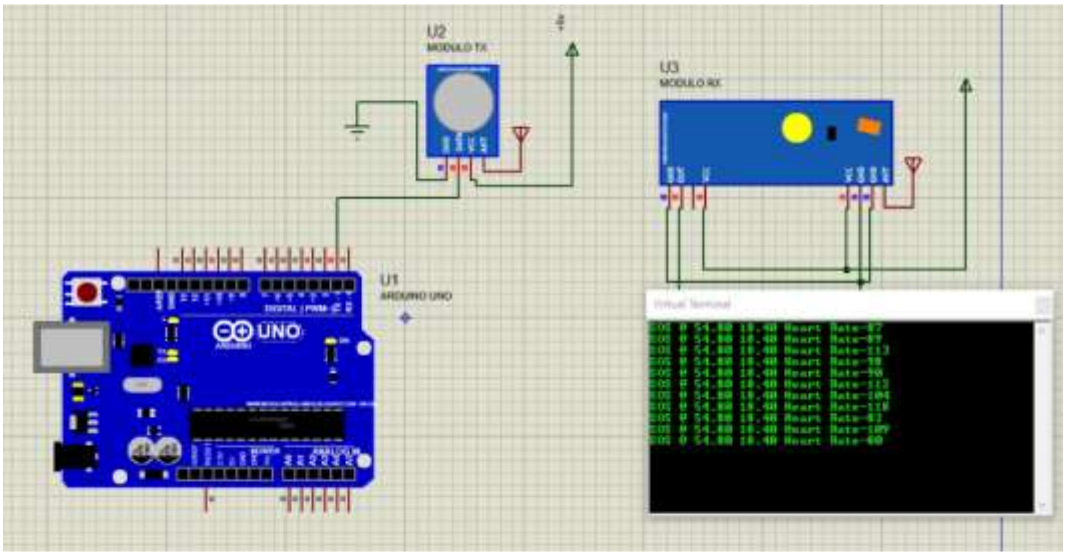


Figure - transmission of string with variables which denote latitude, longitude and heart-rate

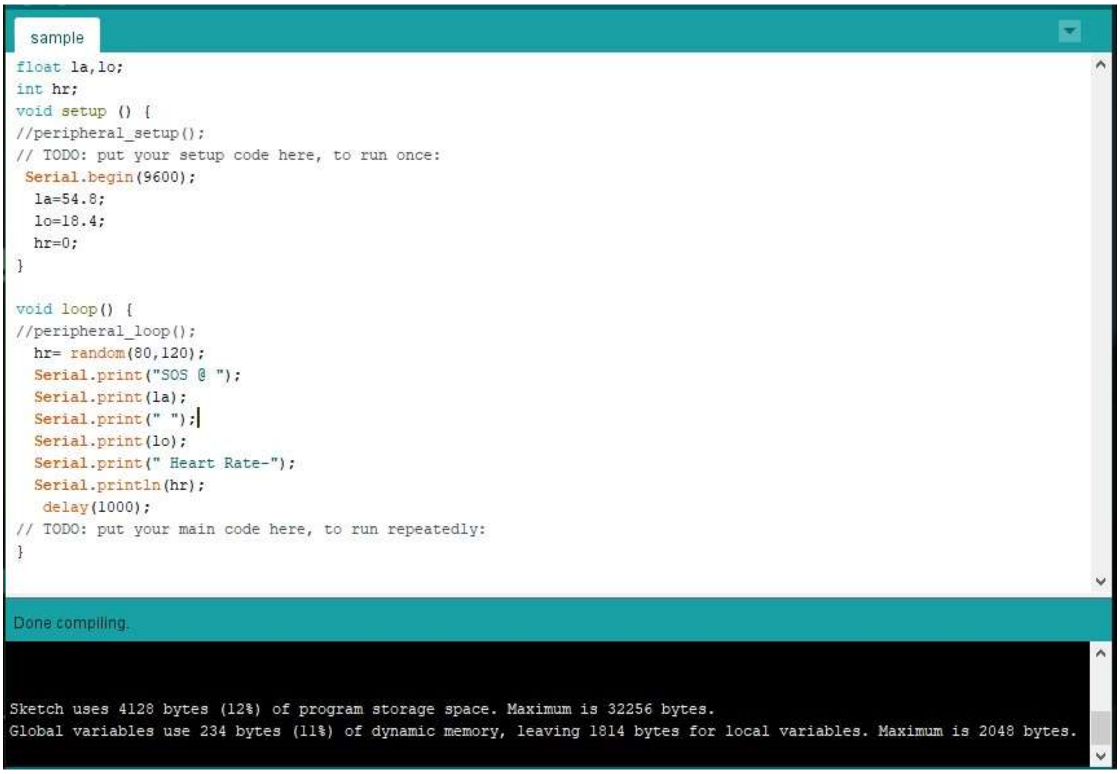


Figure - Compilation of the transmitter code

-Status:

Transmission and Receiving of the data is done. Abstraction of variables from receiver and working on variables need to be done.

In case of increasing range of communication, we would require to changing the module itself.

Solution:

Due to library file errors, the heart-rate sensor is omitted and the water sensor code was run. To make this water sensor run, no additional library required as it can be used as analog input. So a threshold value is enough to make it work.

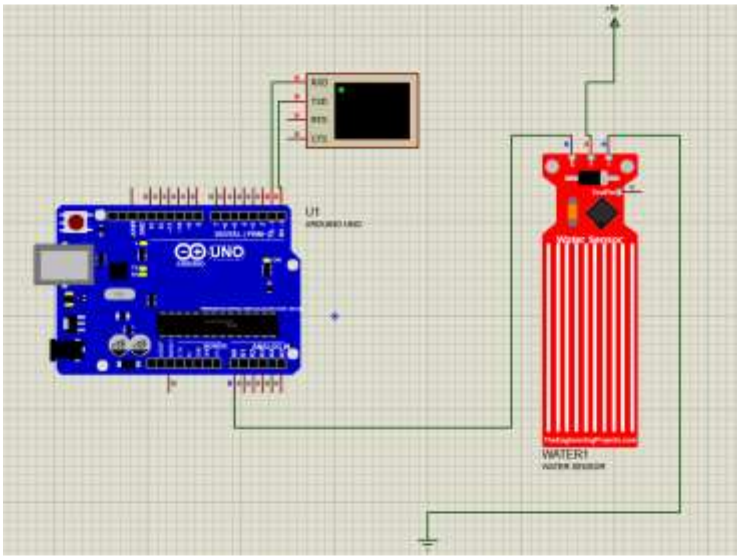


Figure: Final Danger Detection Circuit

The red and blue solid squares denote the exchange of information. With this we can conclude that the danger detection functions properly.

The following are the stages of the second half of the project. This is the result from testing the radio transmission and receiving parts and the GPS parts. As both GPS and Radio transmitter use Serial I/O, first software serial was used to get the output. But since it's a simulation and we have no hardware drawbacks, we upgraded to Arduino Mega as it has 4 sets of Serial I/O.

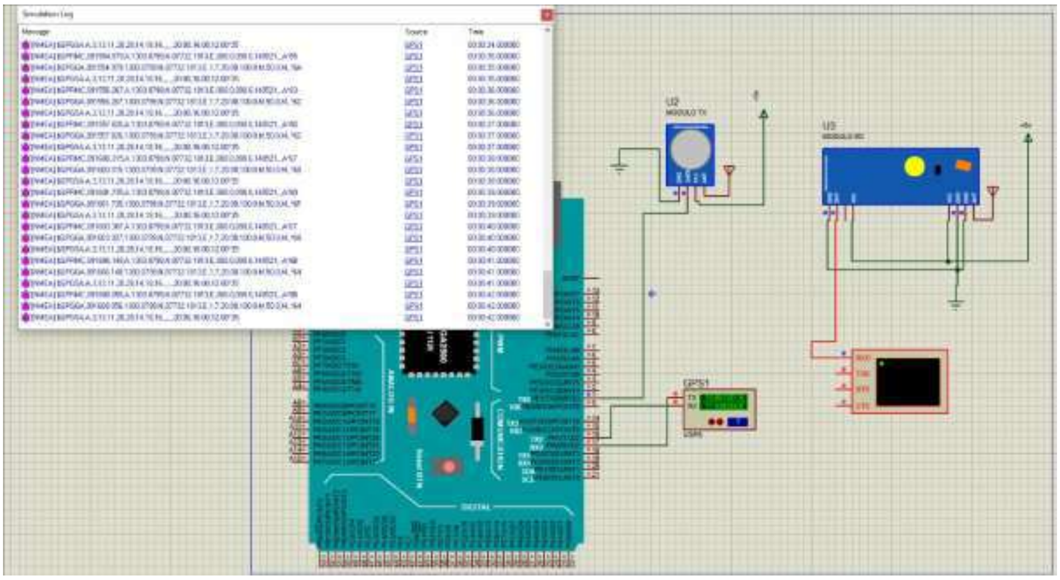


Figure: GPS coordinates being pushed through RF transmitter to receiver

This is the output of the Second part. The GPS data is fed into Arduino Mega which is transmitted and the receiver prints it in the virtual monitor, which in real case would be LCD display, displaying GPS Location.

Conclusion:

By running the second part of the circuit under a threshold condition of the first circuit makes our project a complete success. The final circuit is:

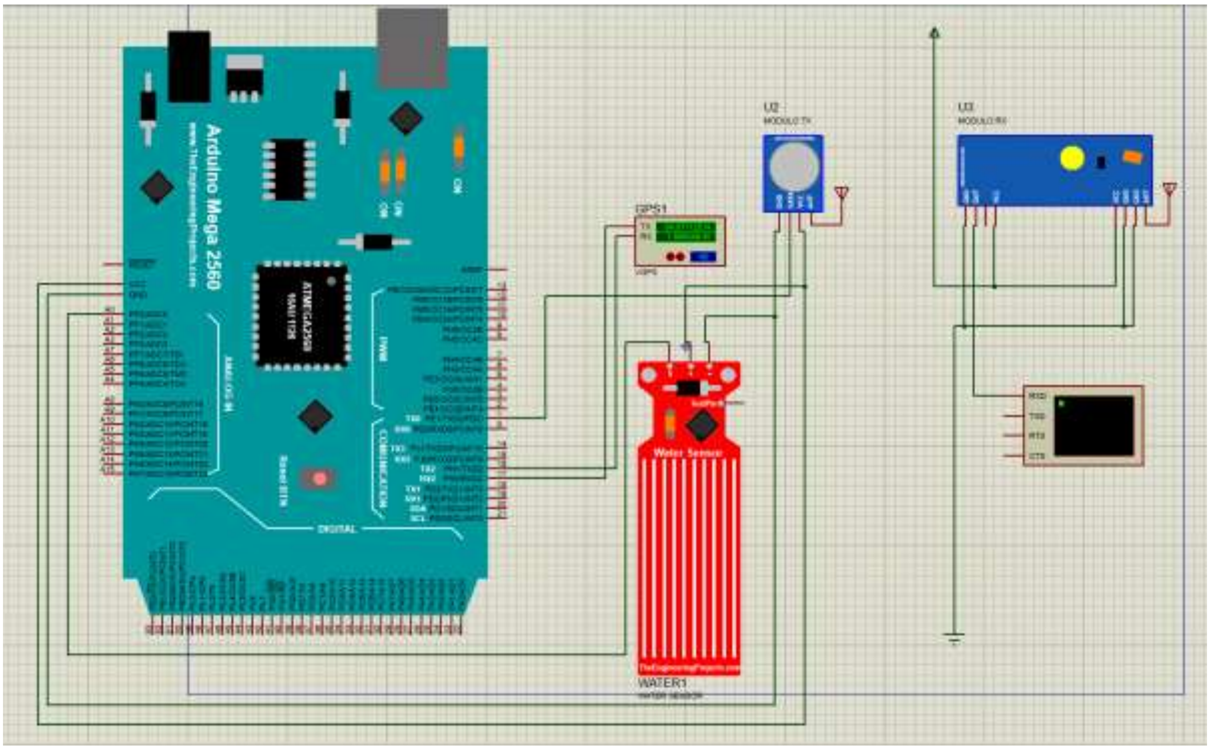


Figure: Final Circuit

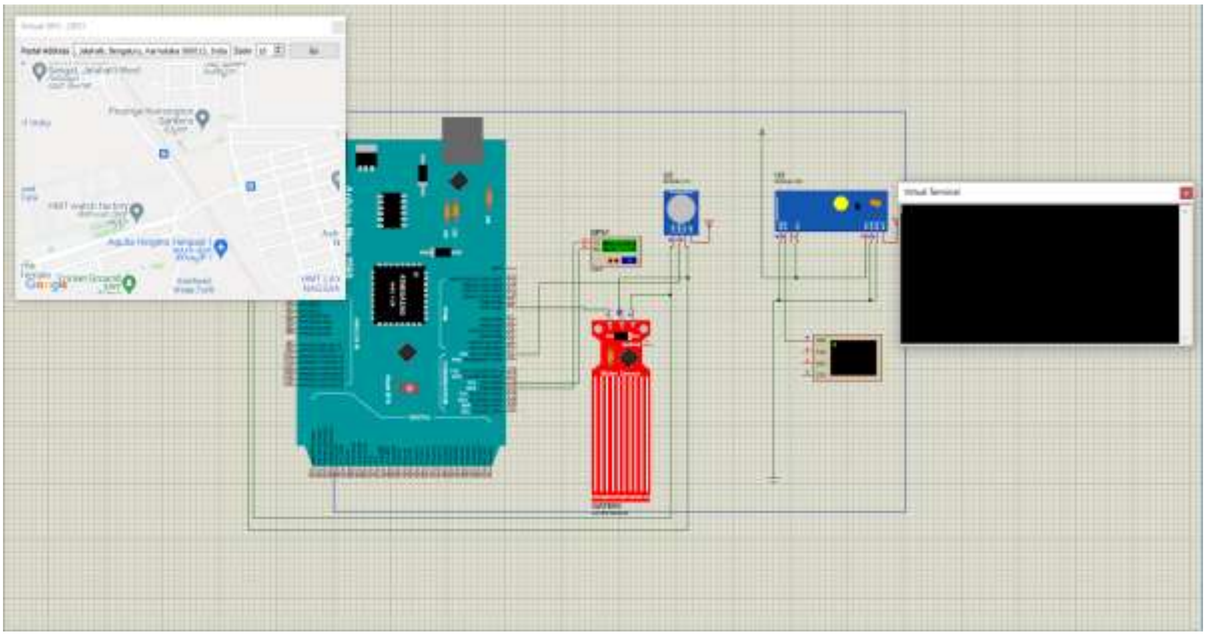


Figure: Output when the water is not detected, the receiver doesn't receive any GPS data

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Arduino CODE

```
#include <TinyGPS++.h>            // Include TinyGPS++ library
#define Grove_Water_Sensor 8 //Water sensor set at Pin 8 (digital)
TinyGPSPlus gps;
byte Danger=0;              //danger detection byte
void setup(void) {
 pinMode(Grove_Water_Sensor, INPUT);
 Serial.begin(9600);
 Serial2.begin(9600);
}

void loop()
{
  if( digitalRead(Grove_Water_Sensor) == LOW) {
      Danger=1; //Danger detected
  }
  if(Danger==1){
  while (Serial2.available() > 0) {

    if (gps.encode(Serial2.read())) {

      if (gps.location.isValid()) {
        Serial.print("Latitude   = ");
        Serial.println(gps.location.lat(), 6);
        Serial.print("Longitude  = ");
        Serial.println(gps.location.lng(), 6);
      }
      else
        Serial.println("Location Invalid");

      if (gps.altitude.isValid()) {
        Serial.print("Altitude   = ");
        Serial.print(gps.altitude.meters());
        Serial.println(" meters");
      }
      else
        Serial.println("Altitude Invalid");

      if (gps.speed.isValid()) {
        Serial.print("Speed      = ");
        Serial.print(gps.speed.kmph());
```

```
          Serial.println(" kmph");
        }
        else
          Serial.println("Speed Invalid");

        if (gps.time.isValid()) {
          Serial.print("Time (GMT) : ");
          if(gps.time.hour() < 10)     Serial.print("0");
          Serial.print(gps.time.hour());
          Serial.print(":");
          if(gps.time.minute() < 10)   Serial.print("0");
          Serial.print(gps.time.minute());
          Serial.print(":");
          if(gps.time.second() < 10)   Serial.print("0");
          Serial.println(gps.time.second());
        }
        else
          Serial.println("Time Invalid");

        if (gps.date.isValid()) {
          Serial.print("Date       : ");
          if(gps.date.day() < 10)      Serial.print("0");
          Serial.print(gps.date.day());
          Serial.print("/");
          if(gps.date.month() < 10)    Serial.print("0");
          Serial.print(gps.date.month());
          Serial.print("/");
          Serial.println(gps.date.year());
        }
        else
          Serial.println("Date Invalid");

        if (gps.satellites.isValid()) {
          Serial.print("Satellites = ");
          Serial.println(gps.satellites.value());
        }
        else
          Serial.println("Satellites Invalid");
       }
     }
   }
}
```