IoT Sensor System to Record The Temperature and Location for Ladles Used In Metallurgy

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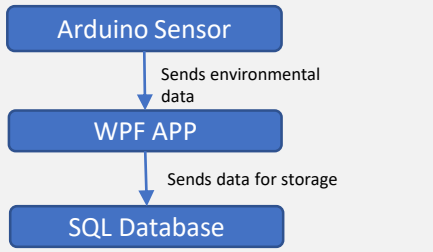
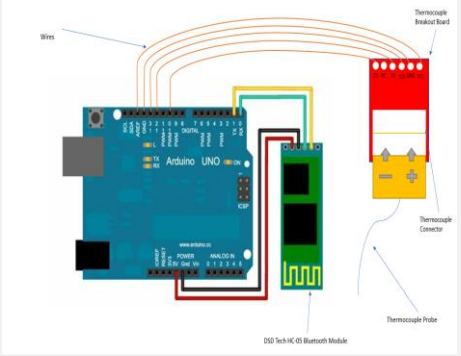
Scope

My project is to create an Arduino sensor system that can record the temperature and GPS location each second.
Each Arduino in the sensor system will communicate with a nearby windows device to display and store the information in a Windows Presentation Foundation (WPF) application using Bluetooth.
Material Processing Institute are a company in Teesside that create meatal castings and require this solution to improve their metal making process.





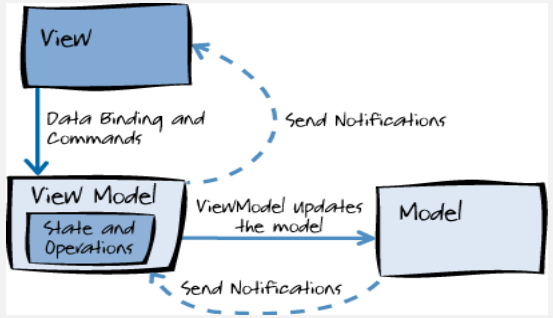
Objectives

My objective is to create a system capable of the following:

- Record Current Environmental Temperatures
- Record Current GPS Location
- Communicate with nearby Windows device using Bluetooth
- Store the data locally on the sensor if the Bluetooth connection fails
- Display the sensor information on a WPF application
- Store the data in a SQL database

Project Design

Throughout the project, I aim to use the Agile methodology as it is widely used in the industry. The work will be split into weekly sections with a sprint review each week.
The WPF application will be structured the Model-View-ViewModel architecture pattern. The pattern allows for code separate leading to stronger, more reusable code *(The Model-View-ViewModel Pattern, 2018).*



Research & Analysis

The world is becoming more dependent upon computers and sensors to tell us real- time data. It is predicted that in 2020, the number of smart devices will exceed 38.5 billion.

The reasoning for using Arduino's is because they are very cheap, and their parts are easily configurable and replaceable *(What is Arduino)*.

A Type-K Thermocouple will be used to record the temperature, a similar implementation was found which I will base my project on.

Hardware & Software

Hardware required:

- 2 x Arduino Uno
- 2 x DSD Tech HC-05 Bluetooth
- 2 x Type K Thermocouple
- 2 x DS3231 Date Time
- 2 x GPS Shield 1.1
- 2 x Breadboard
- 1 x Windows Laptop

Software required:

- Visual Studio 2019
- Arduino IDE
- SQL Management Studio

Constraints & Problems

A problem that I have identified is running multiple Serial Peripheral Interfaces (SPI) devices from one Arduino. An SPI device is a communication method used between devices for fast transmission. The SPI devices I am using in the project require pins twelve and thirteen on the Arduino, therefore I must devise a method for the devices to be able to share these pins.

Another aspect that will be challenging will be recording data if the Bluetooth signal fails, as the Arduino has a small, limited memory.

Project Timeline

The initial project timeline can be seen below, the majority of the application has already been completed and I am ahead of schedule. More features are being considered and added to compensate for the additional time remaining.
Some current tasks being developed are:

- Adding GPS
- Storing the data on a Micro SD card if the Bluetooth connection fails
- Investigating machine learning and SSRS reports

	02-Jan	27-Jan	03-Feb	01-Feb	17-Feb	24-Feb	02-Mar	09-Mar	16-Mar	23-Mar	30-Mar	06-Apr	Status
Initial Documentation													COMPLETE
WPF Setup													COMPLETE
Design Documents													ToDo
Connect Sensor System													COMPLETE
Read temperature data													COMPLETE
Send data to wpf app													COMPLETE
Database setup													COMPLETE
View live data readings													COMPLETE
View history data													COMPLETE
Search for devices runtime													COMPLETE
GPS													COMPLETE
SD Card													COMPLETE
Real-Time clock													COMPLETE
Bluetooth error handling													COMPLETE
Machine learning													ToDo
Report													ToDo

Academic & Images References –

What is Arduino. (n.d.). Retrieved from Arduino: https://www.arduino.cc/en/guide/introduction

The Model-View-ViewModel Pattern. (2017, 07 08). Retrieved from Microsoft Docs: https://docs.microsoft.com/en-us/xamarin/xamarin-forms/enterprise-application-patterns/mvvm

MVVM Design Image - https://stackoverflow.com/questions/47914573/mvvm-design-pattern-relation-between-viewmodel-and-model?noredirect=1&lq=1

Essential WindowsPresentation Foundation (WPF) –Book, containing all information necessary to develop WPF applications.

Arduino, S.A., 2015. Arduino. *Arduino LLC*.

Legal, Social & Ethical Issues –

One of the main ethical issues I will need to consider will be the recording and safe storage of the temperature data. As this temperature data could be considered sensitive, I may need to restrict access and ensure the data is stored safely in the SQL database. For this, I will add user accounts with appropriate levels of access to the SQL server.

I will also need to consider issues that may arise whilst recording the temperature data such as the connection between the sensor and the windows device dropping and how I can professionally handle the data in this case.

Another security issue I will need to consider will be protecting the Bluetooth devices to ensure only authorized users can access them. For example, adding a Bluetooth code so only users who know the code can access the Bluetooth data.

As this is a live project, I will need to clarify the ownership and intellectual property of the artefact, between myself, the company and the university

Professional skills relate to future employment as a computing professional –

The world is becoming more dependent upon computers and devices to automate tasks and improve efficiency. In 2020, the number of connected devices is 38.5 billion which is an increase of 13.4 billion for 2015. With this trajectory, humans will continue to use more IoT devices and the demand for skilled programmers will intern increase. Therefore, I believe this project will help me “stand out from the crowd” when applying for graduate opportunities.

As the project is for a live company, I will be able to add the work experience to my CV and increase my chances of employment in the future. The experience will showcase that I can work in a team and develop a high-quality application.