**Software Requirements Specification**

**Intelligent Manhole Cover system**

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**1. Introduction**

* 1. **Purpose**

A smart city is a collection of intelligent systems and end-to-end services, and the data and information needed for the As the most widespread infrastructure, manhole covers can be found in every corner of the city. As the most widespread infrastructure, manhole covers can be found in every corner of the city. Manhole covers are a very important part of the urban drainage system, connecting the sewer to the ground. In the past few years, incidents of people's property loss due to lost or damaged manhole covers or construction have been common, and lost or damaged manhole covers often pose a great threat to the safety of the public. Ensuring that manhole covers are intact provides great safety for pedestrians and vehicles on the road, and also ensures the normal operation of the municipal drainage system. The goal of this project is to create a smart manhole cover based on Arduino microcontroller combined with various sensors, which comes with various functions and connected with big data platform. It can realize real-time monitoring of environmental temperature, humidity and other data, and display on the big data platform whether the manhole cover is missing or offset, and monitor whether the sewer is blocked.

* 1. **Scope**

This Software Requirements Specification is intended for:

1. Cultural display platform development team leader
2. All project team members
3. Test team member
4. Other personnel the project team authorized to access this document

The application allows users to:

1. Accurately locate the position of the manhole cover by GPS module.
2. Able to receive alarm messages from the smart manhole cover when it is damaged or lost.
3. Ability to view the data collected by the smart manhole cover on the Android operating system.
4. Monitoring the temperature, humidity and rainfall of the ground detected by the sensors through the data platform.
   1. **Overview**

SAS gives a comprehensive description of the functions of the software, helps users judge the correctness, consistency and completeness of the functions, and urges users to think about the software requirements thoroughly and comprehensively before the software design starts. SAS describes all the information required for software implementation and provides a baseline for software design, validation, and validation.

The specific content of requirements analysis can be summarized into six aspects: functional requirements of software, interfaces between software and hardware or other external systems, non-functional requirements of software, reverse requirements of software, limitations in software design and implementation, and reading support information.

The software requirement analysis should provide all the information about the functional requirements of the software, which requires that the content of the software requirement analysis should be correct, complete, consistent and verifiable. In addition, in order to ensure the quality of software design and facilitate the rest and verification of software functions, the expression of SAS is not bifurcated, traceable and modifiable.

**2. The Overall Description**

**2.1 Product Perspective**

* + 1. Hardware Interfaces

GPS Module

Integrated RF chip, baseband chip and core CPU, plus the relevant peripheral circuitry to form an integrated circuit.

Temperature and Humidity Sensor: DHT11

DHT11 digital temperature and humidity sensor is a temperature and humidity composite sensor with a calibrated digital signal output, which applies a dedicated digital module acquisition technology and temperature and humidity sensing technology to ensure high reliability and excellent long-term stability. The sensor includes a resistive humidity sensing element and an NTC temperature element, and is connected to a high-performance 8-bit microcontroller. Its accuracy is ±5%RH, ±2℃, and the range is 5-95%RH, -20~+60℃.

Water Sensor

It is an easy-to-use, small, lightweight, cost-effective water level/drop detection sensor that measures the size of water drops/volume by a series of exposed parallel wire traces to determine the water level.

Arduino

Arduino boards are designed to use a variety of microprocessors and controllers. These boards are equipped with a set of digital and analog I/O pins and can be connected to various expansion boards or breadboards and other circuits.

ESP8266 NODEMCU module

The development board with ESP8266 chip features Tensilica's Xtensa 32-bit RISC LX106 microprocessor ESP-12E module. Its powerful processing capabilities along with built-in Wi-Fi/Bluetooth and deep sleep operation make it ideal for IoT projects.

* + 1. Software Interfaces

The software used in this project includes the Arduino Software IDE, a set of cross-platform applications written in Java, derived from the Processing programming language and the Wiring Project's integrated development environment.

**2.2 Product Functions**

The abilities that mobile users will be able to perform are listed below.

|  |  |
| --- | --- |
| Feature Number | Feature Name |
| 1 | User Login |
| 2 | Map of manhole cover distribution |
| 3 | Display of environmental information on manhole covers |
| 4 | Alarms and maintenance |
| 5 | Settings |
| 6 | Help Menu |

The functions that the smart manhole cover will be able to perform are listed below.

|  |  |
| --- | --- |
| Feature Number | Feature Name |
| 1 | Temperature detection module |
| 2 | Humidity detection module |
| 3 | GPS positioning module |
| 4 | Water level detection module |

**2.3 User Characteristics**

Most of the functionality of the system is determined by the user's needs. Therefore, it is very important to analyze the users. The user group of our mobile application is mainly the staff of the sewerage administration. Most of the users in this category are adults, and their expertise and technical level is sufficient to help them quickly grasp the use and functionality of the system. The administrators of the system need to have considerable technical knowledge of mobile applications. They need to know how to make a new version and update it. The administrator should also be aware of any changes in the manhole cover to keep it up to date and provide the right information.

**2.4 Assumptions and Dependencies**

There are many factors affecting software, including internal factors and external factors. However, any differences to this software will affect the requirements of SRS.

1. Eligibility of team members. Team members should have diverse background in order to cover all the aspects of this project.

2. Plan feasibility. Whether the plan is made properly according to the requirements of clients and if this plan can be finished in time.

3. Detection accuracy: In this project we need manhole to detect the humidity, water level and if there’s a backup in the underground.

4. Device durability: Since this device has to be put in humid environment for a long time. We have to consider the material of this manhole as well as the detection device inside.

**2.5 Apportioning of Requirements**

There are many different requirements to the project. With many-time iterations, the requirements change accordingly. The requirements need to be apported properly. Here are the division of requirements as well as work in the future.

1. Humid detection device, in this project, requires humid sensor. We decide to use Arduino to finish this work. With humid sensor, we can successfully detect if the humidity is high or not. If so, the hole in the manhole will open for water to go down.

2. All the devices need to be waterproof since it has to endure the rain or the water under it. Therefore, we can put waterproof material outside the device.

**3. Specific Requirements**

**3.1 Functions**

This project is designed for manholes in the world. It’s not just for the manholes in WKU. However, we can apply this manhole to WKU first. Then, we can apply this to Wenzhou, or even more places in the world. Using this manhole, we can detect if the humidity outside this manhole is too high. In this way, the holes in the manholes will open accordingly in order to prevent the road from accumulating too much water. We also decide to put GPS device in this intelligent manhole because it can prevent other people steal it. If it’s not in its original place, the system will warn the system manager. Another function is that it can detect if the water level under it is too high or not. We can check the information in the system by checking in the system.

**3.2 Performance Requirements**

This project requires the internet. It can help anyone with permission to check the environment near the manhole. Meanwhile, if there’s any situation happening, there’ll be warning displaying in the system. For example, if these manholes change their locations, or the water level underground is too high, corresponding warning message will display directly.

**3.3 Design Constrains**

In this project, we will use Arduino to make detection and warning device. And we have to make a system containing all the information. For example, we can either make an application or webpage to include all the information.

**3.4 Security**

In this project, we tend to make all the information available in the internet so that everyone can check the status of that manhole. But for this product to be secure, we can make procedures for user to log in, so that only those with privilege can check the information. There are so many different cases. But logging-in mode can really ensure the security of that system.

**3.5 Portability**

Portability is how one application can move from one environment to another. The portability of this application is good. We haven’t decided the platform this application uses. But nowadays there are many applications allowing us to create cross-platform application such as uni-app, Flutter, etc. We can use these platforms to create our applications. We can also create webpage for this project to show all the contents. Therefore, the portability of this application is good.