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Ar-Flood Detector

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Abstract: Flooding is widely recognized as a highly perilous natural disaster due to its severe impacts on agriculture, infrastructure, and human lives. Communities situated in regions with lower elevations are inherently more susceptible to experiencing the detrimental consequences associated with flooding. The objective of this project is to design and implement a flood detection system utilizing Arduino UNO, with the aim of identifying early indications of flooding in regions with low elevation. The flood detection system was operated by harnessing solar energy using a solar panel. The system utilized three water sensors as input devices, each capable of detecting the presence of water at distinct levels. The GSM module is a crucial component utilized for the purpose of alerting the user about water levels. Additionally, a buzzer has been implemented to alert users if the water level reaches a hazardous threshold. The implementation of a real-time flood detection system has the potential to mitigate the detrimental effects of flood disasters and effectively safeguard human lives.

Keywords: Arduino, Flood Detector, Solar Powered, GSM Module, Water Sensor

1. Introduction

Natural disasters continue to happen all over the world because of the abnormal climate that the earth experiences due to the global greenhouse effect. A flood is one of the numerous natural disasters that could occur on earth. For instance, in Southeast Asia, it can happen in both urban and hilly locations. Additional rain will lead to bigger flooding, which will result in catastrophic direct or indirect destruction of the land [1]. Due to climate change brought on by global warming, most farmers, fisherman, small business owners, and other groups bear the burden of flooding in these places, primarily flash floods, and other low-lying waterlogged areas. Their scale, frequency, and location are all determined by the basic causes of flash floods [2].

A flood detector system is a system which monitors and detects the early signs of flooding that might occur. The early warning system must be able to deliver timely warning of potential hazards so that the local authorities have enough time to prepare for an efficient response. Various conveniences have been made feasible because of numerous noteworthy advancements in the fields of science and

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technology. The current methodologies necessitate the implementation of a centralized flood detection system, which poses computational complexities. This system relies on the utilization of sophisticated and cutting-edge equipment for its construction.

The proposed flood detection system would utilize an Arduino and GSM module. The primary source of power for this system is renewable energy, specifically solar energy. To harness this energy, a solar panel has been installed to obtain and convert solar energy into electrical energy. A rechargeable lithium-ion battery was used to store up the electrical energy that will be used to power the system. Water level sensors will provide the inputs to the microcontroller when presence of water is detected. As for the output, GSM module will send alert SMS to the user about the level of water and the buzzer will turn on when the water level reaches dangerous level that was set in the system.

1.1 Objectives

The objectives of this project:

i To design a flood detection system embedded with Arduino UNO, water level sensors and GSM SIM900A module.
ii To detect signs of flooding early for the residents that lived in the region often flooding.
iii To provide real-time notification about water levels via SMS using GSM SIM900A module and buzzer.

1.2 Scope of Study

Arduino UNO will be used as a microcontroller. The system will be powered by solar panel which connected to the rechargeable lithium battery. Three water level sensors will be used to detect the presence of water at three different levels. The first water sensor is used to detect water at the low level or “ALERT LEVEL”. Next, the second water sensor is used to detect water at the medium level or “WARNING LEVEL”. And the last water sensor is used to detect presence of water at high level or “DANGER LEVEL”. The system also installed with a buzzer to alarm the users when the water level reaches the high level or “DANGER LEVEL”. The microcontroller will control the GSM module to send SMS to a phone number regarding the level of water.

1.3 Related Study

Zaity et al [3], their study of Development of Portable Water Level Sensor for Flood Management System used an ultrasonic sensor, humidity sensor, temperature sensor, Arduino UNO, and SIM900 GSM/GPRS Shield Icomsat PreviewIComsat make up the prototype of this water level detection system [3]. The receiver and transmitter segments of this prototype are separated. The transmitter module's function was to transmit and display data from the ping sensor. The data transmitted from the transmitter module will be received by the receiver module, which will then transmit it to a device that supports the local telco SIM [3]. The operation of the data collection for this study begins with the temperature, humidity, and ultrasonic sensors, which transmit the data to the Arduino UNO. Before sending the data to the specified phone number, the Arduino UNO will begin analyzing the data and comparing it to the pre-programmed value. For calibration and error checking purposes, the front panel will also display the data gathered.

Abdirahman Osman Hashi et al [4], in this research of a Real-Time Flood Detection System Based on Machine Learning Algorithms with the Emphasis on Deep Learning, the water level sensor placed in the river which has been selected for the experiment. The water level sensor notices change in the water level that could be normal, above normal, or even dangerous [4]. Following collection, the data was digitalized from its analogue form. The data will be examined by machine learning algorithms like Random Forest, Nave Bayes, and J48, which have been trained to determine whether a critical condition exists or not. Depending on their accuracy, these computer algorithms would classify things. To the

PIC microcontroller, the gathered data will be sent. the PIC will evaluate each piece of data according to its accuracy. Finally, the data may be accessed and managed from any location in the area that offers GSM service.

Elmeen Daud et al [5], in their study of Advanced Flood Detection System with IoT consists of ultrasonic sensor, voltage sensor, Arduino UNO, and output module. The ultrasonic sensor will send the data it has gathered directly to the Arduino UNO. Its primary function is to monitor water level and has IoT features. While the output module has been installed inside the resident houses [5]. The Arduino UNO will collect the data, process it and selected output will be sent to the output module. The main feature which has been the difference for this flood detector compared to the other flood detectors is the application of IoT systems. The output module features an IoT which is an application known as Blynk Application will be used to monitor the system from the user's houses. Users will be notified of an early warning signal about the impending flood by receiving an alert from the Blynk Application, or an alert will be given by a nearby dam via IoT. When the dam opens the water gates, the siren and the user will get alert notification from the Blynk Application.

Research by Minakshi Roy et al [6], the system used is made up of various sensors, including humidity, temperature, water level, flow, and ultrasonic ones, as well as a Wi-Fi module, Arduino, LCD, an IoT remote server-based platform, and an Android application with a user-friendly GUI that relays all the crucial information in the image in a visual format [6]. The sensors will monitor and measure a variety of environmental and weather-related data. The Arduino will receive the sensor data on a continuous basis and check it for any anomalies in the sensor values. The Arduino's Wi-Fi module enables it to transmit data using IoT protocols through a Wi-Fi connection to a remote IoT platform. While the data can also be seen using an Android application, the LCD will be used to show the real-time sensor results [6]. The user will be informed via the Android application if any sensor exceeds above a predetermined threshold value. These parameters can be remotely monitored from any location using this technique to monitor flood conditions.

2. Methodology

This chapter will provide insight into the steps that are involved in the preparation of the flood detector utilizing an Arduino UNO. The primary aim of this chapter is to explain the comprehensive procedure, the design synopsis, and the software employed in this undertaking. The methodology flow chart for this system has been included in this chapter, as illustrated in Figure 1.

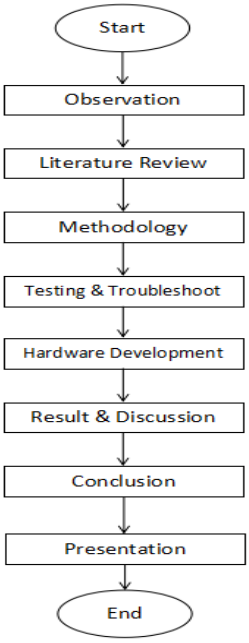

Figure 1: Methodology flowchart of the study

2.1 System Block Diagram

The purpose of the block diagram is to provide a high-level overview of the main system component and the correlation between each component. The block diagram makes it simple to illustrate how the system works as shown in Figure 2.

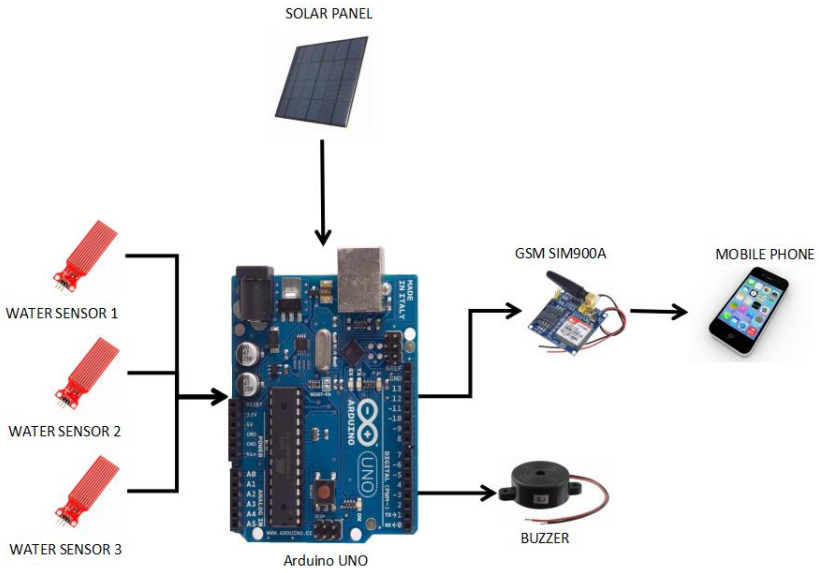

Figure 2: Block Diagram of the system

Firstly, the solar panel, at the foundation of the system, is what converts solar energy into electrical energy, which is then stored in a rechargeable lithium-ion battery. Next, the power from the lithium-ion battery is supplied to the Arduino UNO which will be the microcontroller that run all the process for this flood detection system. Then, one of the inputs from the three water sensors will be sent to the

Arduino UNO when they detect the presence of water. The GSM module will receive the command from the microcontroller to send the alert SMS to the user and notify the user regarding the level of water.

2.2 System Flowchart

The flowchart of this project is shown in Figure 3.

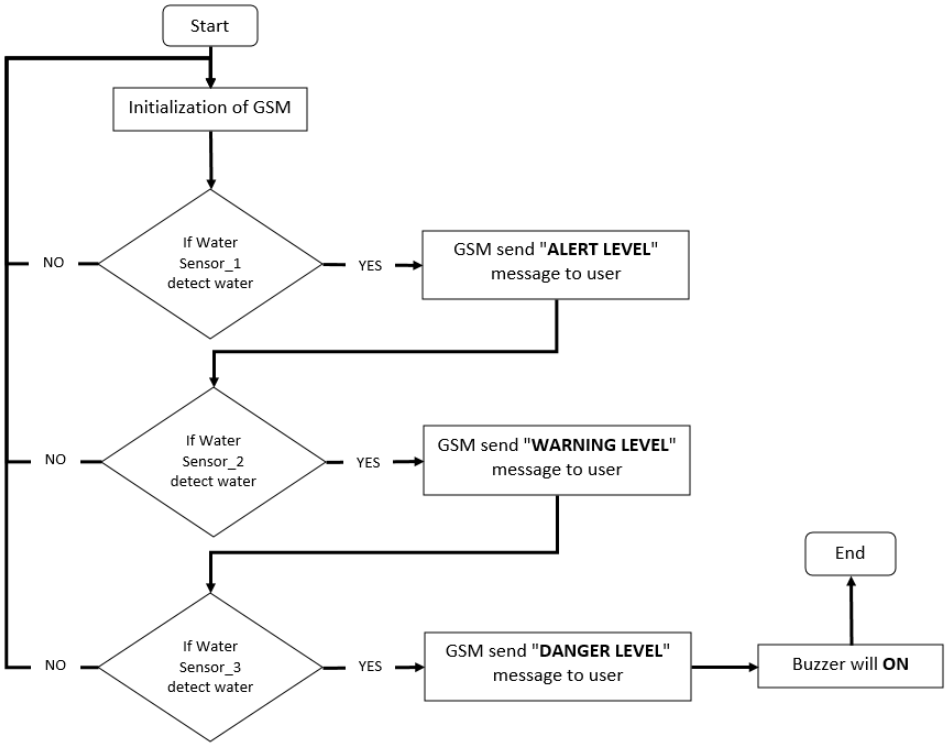

Figure 3: System Flowchart

The purpose of each piece of equipment is established when creating the flow chart for this project. Three water sensors were used in this project to detect three different levels of water. Firstly, when the first water sensor detects the presence of water, the GSM Module will notify the user with SMS such as “ALERT LEVEL”. While, if the second water sensor also detects the presence of water, the user will receive SMS such as “WARNING LEVEL”. Then, the GSM Module will send SMS such as “DANGER LEVEL” to the user mobile number when the third water sensor also detects the presence of water. And the buzzer will be activated for about 20 seconds.

2.3 Layout Design

The design of the prototype of Ar-Flood Detector is shown in Figure 4.

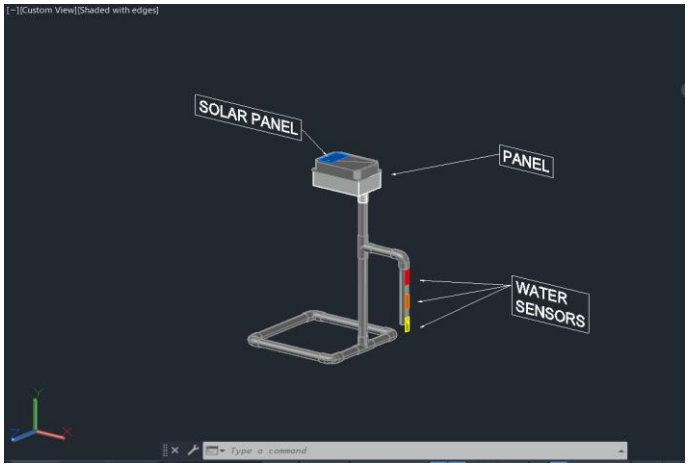

Figure 4: Layout Design

The 3D layout diagram is an overview of the prototype for the flood detection system. AutoCAD has been used for the drawing and designing of the prototype. The prototype was divided into two sections which are pole and panel box. A PVC pipe will be used as the pole of the prototype. PVC is short for polyvinyl chloride. It is a polymer of chlorinated hydrocarbons. It is hard and brittle in its native state. However, it becomes more flexible and resilient when mixed with chemicals like plasticizers. PVC pipes are used because they are simple to install and maintain and have good resistance to heat and corrosion. An outdoor electrical junction box will be used for the panel box section. The outdoor junction box is strong and durable for outdoor applications.

3. Results and Discussion

3.1 Assembly of the Components of the Ar-Flood Detector

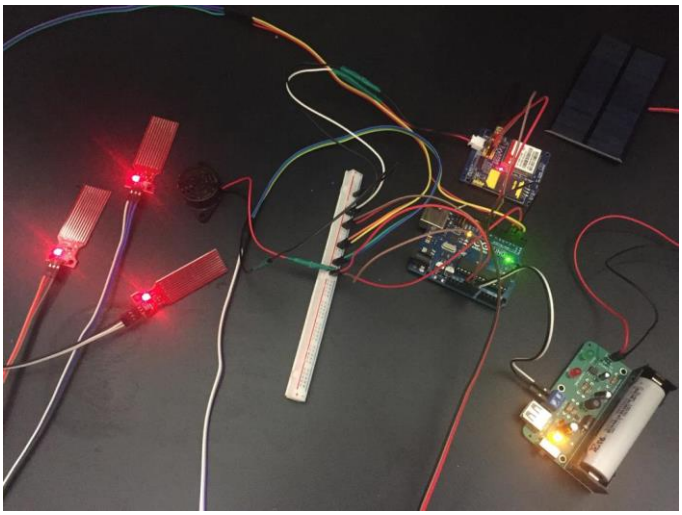

Figure 5: Schematic Diagram of Ar-Flood Detector

The assembly of the components of the Ar-Flood Detector is shown in Figure 4.5. From the diagram shown below, all the pins for GND and VCC are well connected to the pin 5V and pin GND of the Arduino UNO respectively.

3.2 Function of Components

The functions of each component are shown and described in Table 1.

Table 1: Function of the Components

Components	Functions
Water sensor	• To detect the presence of water and send inputs to the microcontroller for further actions to be carry out
Buzzer	• Act as an alarm in the system and alerting the user of danger approaching
Arduino UNO	• Act as the microcontroller of the system that carried all the process • To receive inputs from the water sensors and send it to the GSM module
GSM Module	• To notify the user via SMS regarding the level of water
Solar Panel	• Using for absorbing the light energy and convert to electrical energy • To charging the rechargeable lithium-ion battery which is the main power supply for the system

3.3 Analysis

The hardware and equipment used in the development of this flood detection system. The system includes a solar panel which absorbs light energy from sunlight, a lithium-ion battery that is used as the power source of the system, and an Arduino UNO microcontroller act as the central processing of the system along with a buzzer for the alarming system. The system also includes three water sensors which are used for the detection system and inputs of the system. The GSM SIM900A is also included in the system which allows the user to be notified via SMS sent to the registered phone number when the rise in the water level been detected by the system. The final product of this project is shown in Figure 6.

Figure 6: Ar-Flood Detector

3.4 Data of flood

The primary goal of the flood detection system is to accurately ascertain the water level and promptly notify the user in the event of a flood. To acquire the necessary data for this research, only the section of the flood detector prototype that holds the sensors will be positioned within a substantial container. Subsequently, the large container will be periodically replenished with water. The recorded data is presented in Table 2. The output generated by the GSM module is illustrated in Figure 7.

Table 2: Data of Flood

Water Level from Ground	SMS Sent by GSM Module	Buzzer Sound
15 cm	ALERT LEVEL	NO
16 cm	ALERT LEVEL	NO
17 cm	ALERT LEVEL	NO
18 cm	ALERT LEVEL	NO
19 cm	ALERT LEVEL	NO
20 cm	WARNING LEVEL	NO
21 cm	WARNING LEVEL	NO
22 cm	WARNING LEVEL	NO
23 cm	WARNING LEVEL	NO
24 cm	WARNING LEVEL	NO
25 cm	WARNING LEVEL	NO
26 cm	WARNING LEVEL	NO
27 cm	WARNING LEVEL	NO
28 cm	WARNING LEVEL	NO
29 cm	WARNING LEVEL	NO
30 cm	DANGER LEVEL	YES
31 cm	DANGER LEVEL	YES
32 cm	DANGER LEVEL	YES
33 cm	DANGER LEVEL	YES

Figure 7: Alert SMS notification from the system

3.4 Battery Life

The circuit of the system consists of components such as Arduino UNO, three water sensors, GSM SIM900A module and a buzzer. The whole systems were powered by the lithium-ion battery and charged using the solar panel. To test the battery life, the solar panel was disconnected from the system until the system is completely out of power and then recharged the system back using solar panel. The circuit of the system can be powered for about two days with just eight hours of direct sunlight exposure on the solar panel.

4. Conclusion

The first objective in this project is to design a flood detection system embedded with Arduino UNO, water level sensors and GSM SIM900A module. This objective has been achieved because the

flood detection system has been designed and developed. Next, the second objective is to detect signs of flooding early for the residents that lived in the region often flooding. This objective has been achieved by the implementation of three water sensors in this system and all sensors were able to detect the presence of water precisely. The last objective for this project is to provide real-time notification about water levels to the user. This objective has been achieved because this project has use GSM SIM900A to notify the user about water levels in real-time. To conclude, all the objectives for this project have been achieved.

Acknowledgement

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