CHAPTER ONE

INTRODUCTION

1.0 background of study

A flood is an overflow of water that submerges land which is usually dry. The Floods Directive defines a flood as a covering by water of land not normally covered by water(EU, 2007).

In the sense of "flowing water, the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an area of flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals.

Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers. While revering flood damage can be eliminated by moving away from rivers and other bodies of water, people have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry (Article, 2007).

Some floods develop slowly, while others such as flash floods can develop in just a few minutes and without visible signs of rain. Additionally, floods can be local, impacting a neighborhood or community, or very large, affecting entire river basins.

Flood detector is an electronic device that is designed to detect the presence of water and provide an alert in time to allow the prevention of water damage. Flood alert system which is Arduino Uno based and deals with the possibility of flood (Wikipedia).

The circuit of this system consists of; Arduino Uno, LEDs, HC-SR04 Ultrasonic sensors, 100-ohm Resistor. The system activates as soon as the water rises from normal level to danger level. The sensors send the signals at the speed of 10ms at first to sense the water level and sends. The Arduino Uno is connected with all other parameters which reads signal and sends the signals to the LEDs indicator if the water is in abnormal condition.

Flood detection system is the system is used to detect the rising water level in the river. When the water rises, circuit will send signal to the system. The system will inform the rising of water level to the several departments that in charge the disaster using an indication. The main purpose of flood detection system is to avert or minimize loss of life. We expanded this vision and defined the purpose of the flood detection system as a means of establishing public safety, to reduce damage to property and to relieve public anxiety (Article, 2007).

1.1 Problem Statement

Flood which is not just affecting the economy of Nigeria but also including agricultures, infrastructures and properties will become too much strain to the affected persons. Furthermore, it also will take toll on the houses and it becomes too risky to live. The worst thing is, it can cause death to the civilians. Life is worth. Many people have died because of flood. We cannot predict when this could happen. The people in the area that is consequently having flood and also for government to take action as soon as possible to save their life and do what the best solution to prevent death caused by this disaster. In many regions, effective and reliable flood detection systems are not available. Therefore, there is need to develop a flood detector system that would be used to detect the rising level of water which may cause flooding and resulting in the loss of lives and properties.

1.2Aim andObjectives and of the project

- **AIM**

The aim of this project is todevelop a flood detection system.

- **Objectives**

To develop thismicrocontroller-based Flood Control System, one objective has been taken into Consideration. The objectives are to;

- To design a prototype that could detect flood.
- To integrate the prototype to entire prototype to give a perfect result.
- To evaluate the prototype that its meeting its functionalities.

1.3 Methodology

This project includes two part; hardware and software. The hardware part, this covers the design of the flood controller, which is controlled by (Arduino Uno) microcontroller.

Software environment enable this hardware to accomplish this task so we used C language to program the system.

1.4 Overview of the project

The various chapters and what they talk about concerning this project work are mentioned below;

Chapter 1 gives a brief introduction of the project and explains about the aim and objectives of making the Microcontroller (Arduino Uno) based flood alert system. I have done my research about how this flood control system can be achieved using an Arduino board together with a light emitting diode and an HC-SRO4 Ultrasonic sensor, 100-ohms Resistor. I have briefly described the system and explained how the level of water is controlled using HC-SRO4 Ultrasonic sensors and Arduino. I have also provided a block diagram of the working of the system.

Chapter 2 of this work gives the literature review of this research work (Flood Control System using Micro-controller).

Chapter 3 consists of the Flood Control system design, basic components of the system, input and output units and elaborates about the blocks diagram of this system.

Chapter 4 this talks about the progress of this project work that’s, the implementation of the system, the source code and the result of this work.

Chapter 5 this talks about the conclusion and recommendation of this research work.

Chapter two

Literature Review about Flood Detector

2.0 Introduction

There are few places on Earth where people need not be concerned about flooding, any place where rainfall is vulnerable, although rain is not the only impetus for flood.

A flood occurs when water overflows or inundates land that's normally dry. This can happen in a multitude of ways. Most common is when rivers or streams overflow their banks. Excessive rain, a ruptured dam or levee, rapid ice melting in the mountains, or even an unfortunately placed beaver dam can overwhelm a river and send it spreading over the adjacent land, called a floodplain. Coastal flooding occurs when a large storm or tsunami causes the sea to surge inland (Wikipedia).

Most floods take hours or even days to develop, giving residents ample time to prepare or evacuate, others generate quickly and with little warning. These flash floods can be extremely dangerous, instantly turning a babbling brook into a thundering wall of water and sweeping everything in its path downstream.

Disaster experts classify floods according to their likelihood of occurring in a given time period. A hundred-year flood, for example, is an extremely large, destructive event that would theoretically be expected to happen only once every century. But this is a theoretical number. In reality, this classification means there is a one-percent chance that such a flood could happen in any given year. Over recent decades, possibly due to global climate change, hundred-year floods have been occurring worldwide with frightening regularity.

Moving water has awesome destructive power. When a river overflows its banks or the sea drives inland, structures poorly equipped to withstand the water's strength are no match. Bridges, houses, trees, and cars can be picked up and carried off. The erosive force of moving water can drag dirt from under a building's foundation, causing it to crack and tumble.

In the United States, where flood mitigation and prediction is advanced, floods do about $6 billion worth of damage and kill about 140 people every year. A 2007 report by the Organization for Economic Cooperation and Development found that coastal flooding alone does some $3 trillion in damage worldwide (Wikipedia). In China's Yellow River valley, where some of the world's worst floods have occurred, millions of people have perished in floods during the last century (Dutch, et al. 2009).

When floodwaters recede, affected areas are often blanketed in silt and mud. The water and landscape can be contaminated with hazardous materials, such as sharp debris, pesticides, fuel, and untreated sewage. Potentially dangerous mold blooms can quickly overwhelm water-soaked structures. Residents of flooded areas can be left without power and clean drinking water, leading to outbreaks of deadly waterborne diseases like typhoid, hepatitis A, and cholera.

But flooding, particularly in river floodplains, is as natural as rain and has been occurring for millions of years. Famously fertile floodplains like the Mississippi Valley in the American Midwest, the Nile River valley in Egypt, and the Tigris-Euphrates in the Middle East have supported agriculture for millennia because annual flooding has left millions of tons of nutrient-rich silt deposits behind.

Most flood destruction is attributable to humans' desire to live near picturesque coastlines and in river valleys. Aggravating the problem is a tendency for developers to backfill and build on wetlands that would otherwise act as natural flood buffers.

Many governments mandate that are residents of flood-prone areas purchase flood insurance and build flood-resistant structures. Massive efforts to mitigate and redirect inevitable floods have resulted in some of the most ambitious engineering efforts ever seen, including New Orleans's extensive levee system and massive dikes and dams in the Netherlands and highly advanced computer modeling. Now disaster authorities predict with amazing accuracy where floods will occur and how severe they are likely to be.

Natural disasters are a worldwide phenomenon and require significant cooperation to address. Recent hurricanes, floods, and other events have illustrated this along with the differences of the effects of disasters on developed countries compared to developing countries. In the recent US flooding due to storms in the Midwest, loss of life and property damaged were minimized due to emergency systems available in the highly developed US, while a storm that ravaged approximately seven states caused twenty deaths and $30 million dollars in damage with only a few left homeless or hungry (Larson, et al. 2014)**.**

2.1 Floods Dangerous in History

The top five deadliest floods in world history occurred when the Huang He (Yellow) River in China exceeded its banks. In 1938, the military opened up levees on the yellow river to prevent the advancement of the Japanese army, which had taken control of Northern China. It is not known exactly how many, but many Japanese soldiers died in the flooding. However, it also affected the local communities. It is estimated that 800,000-900,000 people died in total, however, that number is not certain. In the war-ton villages, many government officials had already left, so official counts were not always done (Dutch, et al. 2009).

The surrounding area was deeply affected for several years following the flooding. The fields were covered with yellow silt that provoked the river's name can pile up higher than the land around it, causing the water to spill out of its causeway and into the flat land surrounding it causing it not to be fertile. Natural ice dams add to the problem. In an effort to control the damage a lot of structures were destroyed. This is considered one of the most significant acts of environmental warfare to ever occur. The river was not returned to its earlier course until 1947 where the Chinese government has built channels, dams and dikes to moderate the flow.

Courtney, Chris (2018) the deadliest China flood or the 1931 Yangtze Huai River flood which occurred from June to August 1931 in China, where between 442,499 to 4 million people were killed hitting major cities such as Wuhan, Nanjing and beyond, and eventually culminated in a dike breach along lake Gaoyou on August 1931. After a drought from 1928-1930, the area of the yangtse and Huai rivers received a lot of snowfall. When it started to melt in the early 1931, the extra water flowed down the river, along with the melting ice and snow. Then heavy continual rains for months caused the river to rise even more. Starting from June, people living in low lying areas had to evacuate due to flooding. The July, 9 cyclone storms which was similar to hurricane hit the region, adding more down pours to the situation(Chris Landsea, et al. 2014). The area received 2 feet of rain in one month. This caused flooding the size of the country of England (approximately 69,000 square miles) it severally affected 8 different provinces and had more moderate effects in many others. Thirty-four thousand square miles (34,000sq.km) of land were flooded, leaving 80 million people without homes. In 1887, natural flooding claimed between 1 and 2 million lives.

The worst dam collapse in history occurred in August 1975, when significant rainfall following a typhoon assaulted the Banquet dam on the Ru River in China. Almost 4 feet of rain poured down in a single day. A smaller dam upstream broke, sending a wall of water rushing downstream. A total of 62 dams failed in the incident, with walls of water between 10- and 20-feet high pouring onto the plains below. In an effort to control the flooding, some dams were deliberately destroyed with hopes of relieving some of the pressure. The dam collapse created the third- deadliest flood in history which affected a total population of 10.15 million and inundated around 30 cities and countries of 12,000square kilometers (or 3 million acres), with an estimated death toll ranging from Approximately 26,000- 260,000 people were killed. The flood also caused the collapse of 5 million to 6.8 million houses. The dam failure took place when many people were preoccupied with Cultural Revolution. In May 2005, the Banqiao dam failure was rated the No.1 in the ultimate 10 technological disasters of the world (Xu Yao, et al. 2008).

Although China takes a frequent beating from flooding, the Netherlands also boast a number of deadly floods in its history. High tides and storms were responsible for the deaths of approximately 100,000 people in the Netherlands and England in 1099. A violent weather pattern known as a "Great Storm" created a storm tide in 1287 that broke a dike and killed up to 80,000 people. The same storm killed people in England. In 1421, the tenth deadliest flood in the world occurred when storms caused dikes to collapse. Water flowed across the lowlands, killing nearly 10,000.

The deadliest natural disaster in American history was the hurricane of 1900 in Galveston, Texas. The Category 4 storm which was the strongest storm of the 1900 Atlantic hurricane season, it left between 6,000 and 12,000 fatalities in the United State; the number most cited in official reports is 8,000 most of this death occurred in and near Galveston, Texas. Storm surge killed many on trains attempting to evacuate the city. Floodwaters destroyed bridges and telegraph lines, keeping those outsides of the city from realizing the extent of the damage for some time.

In fact, storm surge deaths caused by hurricanes dominate the list of flood dangers in the United States.

These include the second most dangerous storm, the Okeechobee Hurricane in 1928, also known as the SAN FELIPE SEGUNDO hurricane, was one of the deadliest flood hurricanes in the history of the North Atlantic basin, and the fourth deadliest hurricane in the United States only behind the 1900 Galveston hurricane, 1899 San Ciriaco hurricane and hurricane Maria. The hurricane killed an estimated 2,500 people in the United States; most of the fatalities occurred in the States of Florida, particularly in Lake Okeechobee. In contrast, Katrina claimed fewer than 2,000 lives.

Other dangerous incidents of flooding include a February 26, 1972, dam failure in Buffalo Creek, West Virginia. The failure of three coal slurry dams let loose a tidal wave of destruction upon the Buffalo Creek hollow in the Logan country, West Virginia. With little or no warning to residents, more than 130 million gallons of dark floodwaters tore through more than a dozen communities in the hollow. By the day end’s, hundreds of homes and vehicles were destroyed, thousands were left homeless, and 125 men, women, and children were dead while injuring more than 1,100 people. Almost all 5,000 of the residents downstream were left homeless.

The dam, declared "satisfactory" only four days before the disaster, set off a chain reaction, as pressure from first broken dam caused a second to burst, and then a third (Kai T. Erikson, 1998).

A 1976 flash flood in Colorado's Big Thompson Canyon after excessive rainfall created powerful water that ultimately killed 144 people and resulted in almost $40 million in damages earned the unfortunate title of the deadliest flash floods in Colorado history.

On July 31, 1976, an estimated 2,500-3,500 people were insides homes, cars or enjoying the outdoors in Big Thompson Canyon in Larimer Country when the skies opened up that evening, dropping larger volumes of water down the slopes and the Canyon floor. Many had little to no warning when a 20-feet wall of water swept through the Canyon that evening of the 144 people who lost lives that day. Since then, the several flash floods have impacted the area, but none as tragic as the 1976 flood. In September 2013, a massive flooding event tore through the Canyon and many other parts of the Front Range and eastern plains. Waters reached speeds of more than 30 feet per second, moving 250-ton boulders with their powerful currants.

The 2013 flood affected 14 countries, killed 10 people, damaged 26,000 homes and entirely destroyed 2000 homes, according to the United States Department of Agriculture.

In the Great Flood of 1993, this was a flood that occurred in the Western United States, due to excessive rainfall along the Mississippi River basin and this triturates from April to October 1993. The flood was among the costliest and devastating to ever occur in the United State, with $15 billion in damages (approx. $27 billion in 2021 dollars). The hydrographic basin affected an area approximately 745 miles (1,199km) in length and 435 miles (700km) in width, totaling about 320,000 square miles ($830{,}000km^{2)}$. Within the zone, the flooded area totaled around 30,000 square miles ($78{,}000km^2$) and was the worst such US disaster since the Great Mississippi flood in 1927, as measured by duration, area inundated persons displaced, crop and property damaged, and number of record river levels. In some categories, the 1993 flood even surpassed the 1927 flood, at the time the largest flood ever recorded on the Mississippi River over a period of several months.

2.2 flood related cases in Nigeria

In 2019, a total of 277,555 people was affected by floods and 158 lost their lives, this disaster resulted in estimated $17 billion damage, according to the Nigeria's National Emergency Management Agency (NEMA). The Nigeria Hydrological services Agency has reported that more than 100 Local Government areas in 33 states have been affected by floods. Thirteen states have been placed on the high alert for severe flooding. In the violence hit Adamawa, Borno and Yobe states risk of more torrential rains and floods remain high until the end of September. As of 30 August, flood had affected around 21,000 households. More than 40,000 men, women and children mostly internally displaced people have little or no access to food or services in the town of Rann, Borno state, due to heavy flooding of the River Kaali in neighboring Cameroon since 7 November.

According to the media reports, since the beginning of 2022, 300 people have been killed in separate flood-related incidents, 100,000 have been displaced and 500,000 affected across the country (UNICEF).

Media report as of 18 October, 603 fatalities, over 2,400 injured, nearly 1,303,000 displaced people and a total of more than 2,504,000 affected people across the Country. In particularly, the Bayelsa State is the worst affected, with around 700,000 either displaced or affected people. In addition, same sources also report around 203,400 damaged houses, of which over 82,000 fully damaged or destroyed.

Flooding has affected over more than 4.4 million people across Nigeria since July, according to the latest update by the National Emergency Management Agency (NEMA). The floods have displaced over 2.4 million people. More than 660 people have lost their lives. The catastrophic floods have also made 174,000 houses unfit for habitation. The flood have destroyed over more than 676,000 hectares of farmlands in some of areas during the harvest season and many more worsen already alarming levels of hunger and mal-nutrition.

2.3 already existing flood detection system

Flood control system using GSM technology is bothhardware-based project that is used to minimize the extent of damages caused by floods. This system is designed to detect the levels of water so that appropriate signals or alerts can be sent to the appropriate station and the public. The specific SMS is sent from the GSM modem to the station through a regular GSM modem network. The microcontroller will continuously check the status of the sensors. The main components of this system of this system are; PIC microcontroller, sensors, display unit and motors. Here the sensor senses the presence of water and gives an indication to the microcontroller. The microcontroller produces the control signals to drive the motor and display the condition ton LCD in the system.

2.3.1 Challenges of flood control system using GSM

Flood control system that uses GSM faces the following challenges;

- Reliability: GSM network can be unreliable in areas with poor network coverage, which can lead to delays or failures in transmitting data.
- Power Supply: Flood monitoring systems require a continuous power supply to function properly. In areas with frequent power outages, this can be a challenge.

- Data Transmission: The transmission of data from sensors to the centralized data management system can be affected by various factors such as network congestions, signal interference, and data loss
- Cost: The cost of implementing a flood control system can be high, especially in areas with limited resources. For example, the cost of sensors, communication equipment's and data transmission systems.

Chapter Three

MATERIALS AND METHODS

3.1 Analysis of existing system

A flood control system using a GSM technology involves the use of a communication system to monitor and warn people about potential flooding. The system typically uses sensors to detect water levels and sends signals or alerts via SMS or phone calls to people in the affected areas

3.1.2 Working principles of the already existing system

This system is a real-time system which keeps on scanning the current condition with one which is present in the microcontroller to check if there is any undesirable condition in the water sensing unit (probe). If they are any undesirable condition the current starts flowing and the microcontroller gets input from the water sensing which identifies and checks the level of water. Four sensor probes are used which are represented by switches one, two, three and four, When the water level is raised each probe starts conducting sequentially as long as the supplied voltage is there. For each switch when closed there is a corresponding output which are displayed on the LCD for indicating the water level for low, medium, high and flooding from the right start of switch respectively and light emitting diode; green, blue, yellow and reds for each switch respectively precisely programming of PIC. When the water level reaches water level three (switch four closed) the system recognized the flood risk, send SMS automatically to the flood monitoring station wirelessly through GSM module using virtual serial port simulator, HyperTerminal, max 232, and compim and a spark sound in the environment.

3.1.3 Problems associated with existing system

- Cost
- Power supply
- Data transmission
- Reliability

3.2 Proposed system

This system will be developed to be able to provide a real-time monitoring of flood levels and issues alerts/signals to nearby residents and authorities in case of a flood. This system will make use of sensors to measure the water levels and flow rates, and a microcontroller will be used to process the data and issue alert/signals.

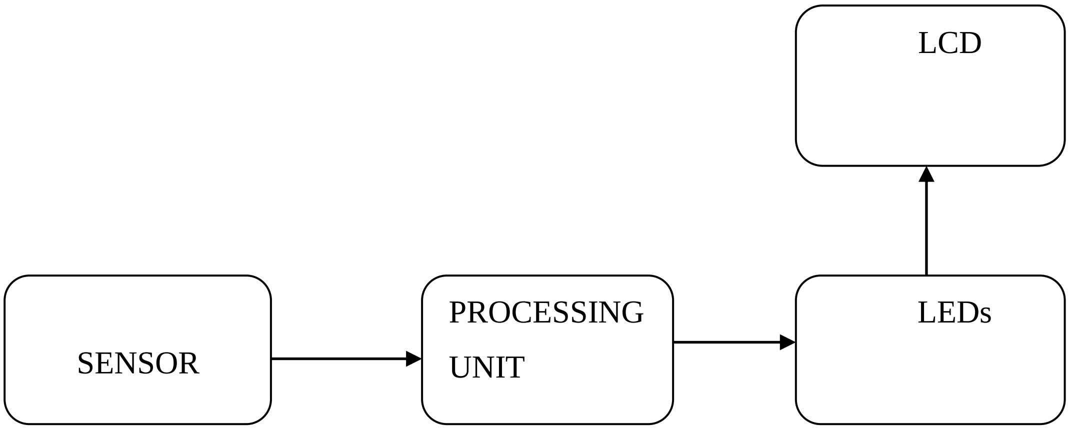

Figure 3.2: block diagram of flooding control system.

3.3 Circuit Design

The circuit design diagram illustrates the components and their connections to create the Flood Detector System. The flood control block diagram, which is made of a level sensor are connected to an ‘‘ARDUINO UNO’’ along with the LEDs.

The main purpose of the ARDUINO (UNO) is to analyze the received signals sent from the level sensors.

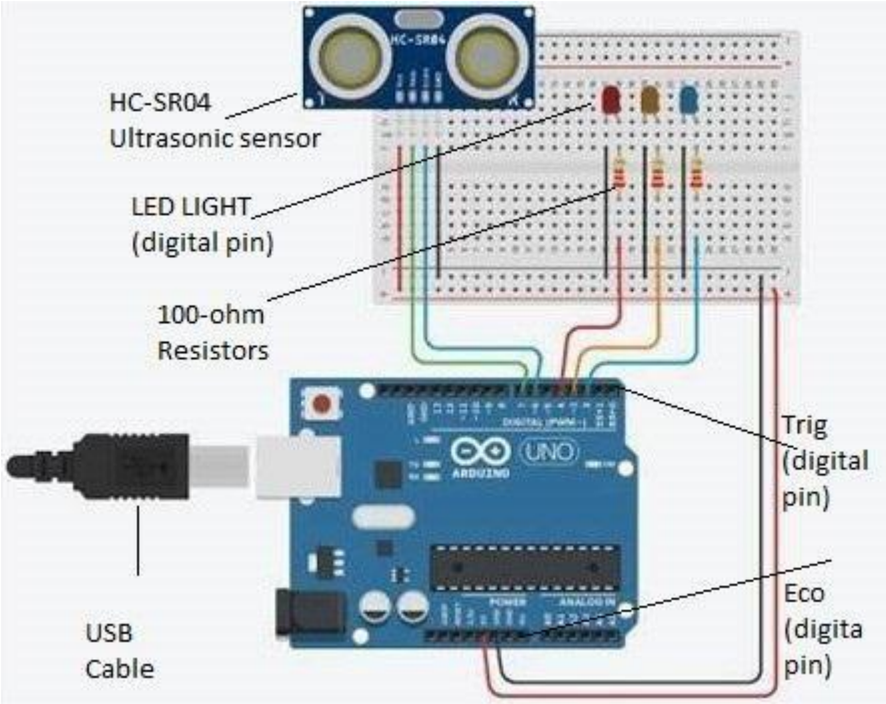

Figure 3.3: Block diagram of the circuit

3.4 Component of the proposed system

Hardware components of Flood control system that can be used are divided into three units each one contains one or more components. These components are explained below as shown in the.

- Hardware component
- Software components

HARDWARE COMPONENTS

The following hardware component for this proposed flood control system includes the following;

- Arduino Uno board
- Ultrasonic sensor
- Light Emitting Diodes (LEDs)
- Resistor
- USB cable

The Processing Unit

The processing unit is an important element in the system. It is the heart of the system that analysis and processes the events that come from the device and controls the output device devices. This unit can be a Microprocessor or Microcontroller

3.5 MICROCONTROLLER

The microcontroller is the computer chip that controls most of the complex electronic devices people use every day, from washing machines and coffee makers to the air bags and anti-lock brakes in cars.

In 1970 and 1971, about the same time Intel was inventing its microprocessor, *Gary Boone*, an engineer at Texas Instruments was working on a similar idea. At that time Texas Instruments was interested in making pocket calculators and Boone designed a single integrated circuit chip that held nearly all of the necessary circuits to make a calculator (except for the keypad and display). This extraordinary breakthrough was given the rather humdrum name of the TMS1802NC, but there was nothing humdrum about the device. Five thousand transistors provided 3000 bits of program memory, 128 bits of random access memory, and could be programmed to perform different functions. While Texas Instruments believed that most sales would initially go to makers of calculators, it saw far-reaching possibilities for the new chip. With a little programming, it could be used to power electronic clocks, scales, and various types of meters. Although the microprocessor could be the basis of a much more powerful computer, it had to have a whole group of additional chips and circuits to make it work; at a minimum in needed memory chips, to use it with a printer, colormonitor, sound card, or disc drive required even more chips. The microcontroller, on the other hand, was an independent device a computer on a chip that performed a more limited range of functions but needed only minimal help from other chips and devices.

Arduino Uno

Arduino is an open source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit AtmelAVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment(IDE) based on the Processing project, which includes support for C and C++programming languages.

The first Arduino was introduced in 2005. The project leaders sought to provide an inexpensive and easy way for hobbyists, students, and professionals to create devices that interact with their environment using sensors and actuators. Common examples for beginner hobbyists include simple robots, thermostats and motion detectors.

An Arduino board consists of an Atmel8-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors which lets users connect the CPU board to a variety of interchangeable add-on modules known as *shields*. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I^2Cserial bus so many shields can be stacked and used in parallel. Official

Arduino's have used the mega AVR series of chips, specifically the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560. A handful of other processors have been used by Arduino compatibles. Most boards include a 5 volt regulator and a 16 MHz crystal oscillator, although some designs such as the Lily Pad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer.

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The decimal duemilanove, and current Uno provide 14 digital I/O pins, six of which can produce pulse-width modulate signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.10-inch (2.5 mm) headers. The Arduino Uno is the heart of the Flood Control System. It serves as the main controller that reads data from the ultrasonic sensor and control the LEDs indicators, as shown in Figure 3.5

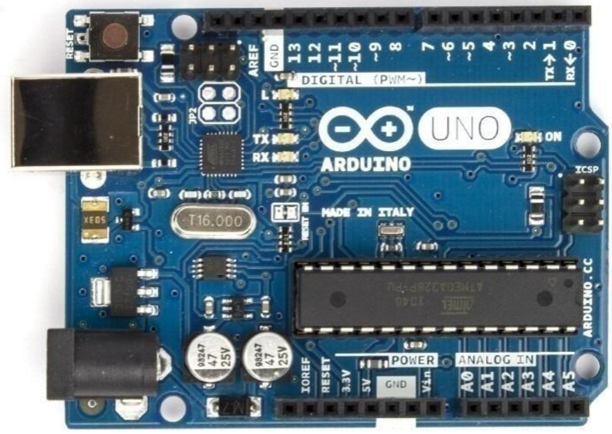

Figure 3.5: Arduino uno board

3.5.1 FEATURES OF ARDUINO

Arduino is a microcontroller board that is designed to make applications more accessible and interactive. It is based on the ATmega328P microcontroller and has several features that make it a popular choice for hobbyist, artist, and designers. Some of its features involve the following;

- DIGITAL AND ANALOG I/O PIN: The Arduino uno board has 14 digital input/output pin of which 6 can be used as PWM outputs and 6 analog inputs.

- USB INTERFACE: The Arduino uno board has a USB connection that allows it to be connected to a computer for power and communication.

- CLOCK SPEED: The Arduino uno board is clocked by a 16MHz ceramic resonator

- EASY TO USE: The Arduino uno IDE (Integrated Development Environment) is readymade software that is used to write and upload computer code to the physical board. This makes it very easy for beginners to get started with programming.

- EXPANDABLE: The Arduino uno board has a larger number of pins, which makes it easier to attach various extension boards. It can also be easily connected to sensors and other devices to create interactive projects.

- It has a 32KB of flash memory for storing code

- It has a button to reset the program on the chip

- It has an ICSP connector for bypassing the USB port and interfacing the Arduino directly as a serial device. The port is necessary to re-boot load the chip if it corrupts and can no longer be used to the computer

- It is an open source design and there is advantage of being an open source is that it has a large community of people using it. This makes it easy to help in debugging projects.

- It is very convenient to manage power inside it and it has a feature if built-in voltage regulation. This can also be powered directly off a USB port without any external power. You can connect an external power source of up to12v and this regulates it to both 5v and 3.3v

- 13 digital pins and 6 analog pins allow you to connect hardware to the Arduino Uno board externally.

- Overall, the Arduino Uno board is a versatile platform and easy-to-use microcontroller that is suitable for a wide range of application.

Output unit

An output device is any piece of equipment used to communicate the result of data processing carried out by an information processing system which converts the electronically generated information's into human readable form

3.6LIGHT EMITTING DIODE

Light emitting diodes (LEDs) are semiconductors that convert electrical energy into light energy. The color of the emitted light depends on the semiconductor material and composition. The LEDs are generally classified into three wavelengths: Ultraviolet, visible and infrared. A P-N junction can convert absorbed light energy into a proportional electric current. The same process is reversed here (i.e. the P-N junction emits light when electrical energy is applied to it). This phenomenon is generally called electroluminescence, which can be defined as the emission of light from a semi-conductor under the influence of an electric field. The charge carriers recombine in a forward-biased P-N junction as the electrons cross from the N-region and recombine with the holes existing in the P-region. Free electrons are in the conduction band of energy levels, while holes are in the valence energy band. Thus, the energy level of the holes will be lesser than the energy levels of the electrons. Some portion of the energy must be dissipated in order to recombine the electrons and the holes. This energy is emitted in the form of heat and light.

LEDs (Red, Yellow, and Green): The system includes three LEDs representing different water levels. The red LEDs indicate a high-water level (very dangerous), the yellow LED indicates the medium water level, and the green LED indicates a normal or low water level. The light emitting diode will be used to indicate the warning signal as shown in Figure 3.6

Figure 3.6: Light emitting diode

3.7 ULTRASONIC SENSORS HC-SR04

Ultrasonic sensors this are electronic devices that uses ultrasonic sound waves to measures distance. They work by sending out a sound wave at a frequency above the range of human hearing, and then measuring the time it takes for the sound wave to bounce back after hitting an object. Ultrasonic sensors are used for ideal detecting of uneven surfaces, liquids, clear objects and dirty surfaces. They are commonly used in industrial application for object detection or level measurement with millimeter precision. The measuring method used by ultrasonic sensors has been viewed as an excessively complex technology, but ultrasonic sensors have proven their reliability and endurance in virtually all industrial sectors. The sensors head emits an ultrasonic wave and receives the wave reflected back from the target.

Ultrasonic sensors measure the distance to the target by measuring the time between immersion receptions. An optical sensor has a transmitter and a receiver, whereas ultrasonic sensor uses a single ultrasonic element for both immersion and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternatively. This enables miniaturization of sensors head.

The ultrasonic sensor will be used in this project to measure the distance to the water surface. It sends out ultrasonic pulses and measures the time taken to echoes to return as shown in figure 3.7

Figure 3.7: Ultrasonic sensors

3.8 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits, resistors are used to limit current flow, to adjust signal levels, bias active elements, and terminate transmission lines among other uses. High-power resistors, that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity. Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can compose of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance will fall within a manufacturing to learner

Each LED is connected to the Arduino Uno through a 100-ohms resistor to limit the current and protect the LEDs from excessive current flow as shown in Figure 3.8.

Figure 3.8: resistor

3.9 USB CABLES

The term USB cable stands for Universal Serial Bus. USB cable assemblies are some of the most popular cable types available, used mostly to connect computers to peripheral devices such as printers, cameras, camcorders, scanners, and more

The USB cables standards allows for the following advantages over serial cable types

- USB cables are ‘’Hot pluggable’’. In other words, you can connect and disconnect the cables while the computer is running without fear of freezing the computer
- USB cables are fast, transferring up to 480Mbps compare that of the serial communication which transfers data at 120Kbps.
- USC cables carry power as well as signals. This allows for ‘’ USB powered’’ gadgets as well as recharging batteries in cameras and other USB peripherals.
- USB cables are designed with several distinct connector types, making it easy to identify which plug goes into the computer and which plug into the peripheral device
- USB cables are a universal standard and are fairly easy to find and to afford.
- As mentioned above the USB cables assemblies are designed with several distinct connector types. The most common types are the TYPE A and TYPE B USB connectors. The different connector types have an important strategic purpose to them. They are designed so you cannot plug two computers into one another, and you cannot plug two peripherals devices together. The USB cable is used to connect the peripheral device (Arduino Uno board) to the computer system.

Figure 3.9: USB cables

3.10 Connections

1. Connect the VCC pin of the HC-SR04 sensor to the 5V pin of the Arduino Uno.

2. Connect the GND pin of the HC-SR04 sensor to the GND pin of the Arduino Uno.

3. Connect the Trig pin of the HC-SR04 sensor to digital pin 2 of the Arduino Uno.

4. Connect the Echo pin of the HC-SR04 sensor to digital pin 3 of the Arduino Uno.

5. Connect the anode of the red LED to digital pin 4 of the Arduino Uno via a 100-ohm resistor.

6. Connect the anode of the yellow LED to digital pin 5 of the Arduino Uno via a 100-ohm resistor.

7. Connect the anode of the green LED to digital pin 6 of the Arduino Uno via a 100-ohm resistor.

3.11 HOW COMPONENTS INTERACT WITH EACH OTHER

1. Sensor Data Acquisition

- The flood detection system utilizes the HC-SRO4 ultrasonic sensor to measure the distance to the water surface.
- The sensor emits ultrasonic waves, which bounce back after hitting the water surface.

- The time taken for the ultrasonic sensor wave to return is used to calculate the distance from sensor to the water surface.

2. Arduino Uno Data Processing

- The HC-SRO4 sensor is connected to the Arduino Uno microcontroller
- The Arduino Uno reads the time taken for the ultrasonic sensor to return using the Trig and Echo pin.
- Using thus time duration, Arduino Uno calculates the distance to the water surface based on the speed of sounds of air.

3. Water Surface Indications

- Once the distance is measure, the Arduino uses predefined thresholds to determine the water level.
- For example, if the measured distance is less than or equal to a certain value, the system identifies it as a high water level, similarly, other distance ranges indicates medium or normal/low Water level.

4. LED indications

- The Arduino Uno controls the LEDs (red, yellow, and green) based on the detected water level.
- When the system detects a high water level, it turns on the red LED, indicating a very high situation.

- If the system detects a moderate level it turns on the yellow LED to dignify a moderate water level.
- If the water level is normal or low the system it turns on the green, indicating a safe condition.

5. Continuous monitoring

- The flood control system continuously repeats the distance measurement and water level determination process.
- It periodically updates the LED indication based on predefined measurements.

4.12 BENEFITS OF THE FLOOD DETECTION SYSTEM

1. Early warning: The system provides early warning signals of potential flooding, enabling residents to take preventive measures before the situation becomes critical.

2. Real-time monitoring: The flood control system continuously monitors the water levels, ensuring that users stay informed about and changes.

3. User-Friendly: The LED indicators make it easy for anyone to understand the water level at a glance, without requiring technical expertise.

Overall, the Flood control system offers a reliable and practical solution for flood monitoring, making it an essential tool for flood-prone areas and ensuring safety and preparedness in the face of potential flooding events.

4.13 SOFTWARE Requirement

The software that was used in this project is called the ARDUINO IDE. It is used to program the ARDUINO and it uses an enhanced C programming language which makes it easier to run the program. The Flood control system is implemented using the Arduino IDE, an integrated development specifically designed for programming Arduino boards. The IDE provides an easy-to-use interface for writing, compiling, and uploading code to the Arduino Uno.

4.13.1 C Programming Language

The C programming language was developed in the early 1970s at Bell Labs by Dennis Ritchiel. It was initially created as a system implementation language for the UNIX operating system. C was derived from the type less language

BCPL and evolved a type structure. It was designed to reflect the capabilities of the targeted CPUs and became widely used in operating systems, device drivers, and protocol stacks.

During the 1890s, C gained popularity and became one of the most widely used programming languages. It is known for its efficiency, flexibility and low-level programming capabilities. C has influenced the development of many other programming languages, including C++, Objective-C and $C^{\#}$.

The development of C was closely tied to the development of the UNIX operating system, and it played a crucial role in rewriting the UNIX kernel in C. Over the years, C has undergone changes and standards and improvements, and a formal standard for the language was adopted in the 1990s. Today C programming compilers are available for practically all modem computer architectures and operating systems. The language continues to be widely used in various fields, including system programming, embedded systems and high-performance computing.

3.13.2 Reasons why I choose the C programming language for this project;

- Low access to memory: C provides direct access to memory which makes it suitable for system programming like operating system or compiler development
- Simple set of keywords: C has a simple set of keywords, which makes it easy to learn and understand.
- Clean style: C has a clean style, which makes it easy to read and write
- Fewer libraries: C programming also clears programming concepts to a great extent as you have to write a lot of things from scratch
- Fast execution time: programs written and compiled in C executes faster than compared to any other programming language.
- Highly portable: C is not constrained by the hardware or operating system on which it is been installed and has the simplicity of its features that allows for further optimization and extension of its capabilities.
- Powerful language: C is a powerful programming language that includes a collection of in-built functions and operators that help in writing any complex program overall, C programming language is suitable for system programming, algorithm and data structure implementation, and writing complex programs.

3.14 Microprogramming

Setup of the Arduino IDE

1. Download and install the Arduino IDE from the official Arduino website. The IDE is available for Windows, macOS, and Linux operating systems.

2. Connect the Arduino Uno to your computer using USB cables.
3. Open the Arduino IDE; select the correct board (Arduino Uno). And choose the appropriate port from the tool's menu. This establishes communication between the IDE and the Arduino board.

C (programming language) Code implementation

```
‘ ‘ ‘ c

//Ultrasonic Sensor Connections

     Const int trigpin =2;

     Const int echopin =3;

// LEDs connections

     Const int redLED =4;

    Const int yellowLed =5;

    Const int greenLED =6;



Void setup() {

      pinMode(trigpin, OUTPUT);

      pinMode(echopin, INTPUT);

      pinMode(redLED, OUTPUT);

      pinMode(yellowLED, OUTPUT);
```

```
pinMode(greenLED, OUTPUT);

}

Float getDistance() {

digitalWrite(trigpin, LOW);

delayMicroseconds(2);

digitalWrite(trigpin, HIGH);

delayMicroseconds(10);

digitalWrite(trigpin, LOW);

Float duration = pulseIn(echoPin, HIGH);

Return (duration/2)/29.1;

}



Void loop() {

Float distance= getDistance();



If (distance <=10 {// High water level (very dangerous)

digitalWrite(redLED. HIGH);

digitalWrite(yellowLED. LOW);
```

```
        digitalWrite(greenLED. LOW);

      } else if (distance>10&& distance<=20) {// medium water level

         digitalWrite(redLED. LOW);

         digitalWrite(redLED. HIGH);

         digitalWrite(redLED. LOW);

      } else {// Normal or low water level

        digitalWrite(redLED, LOW);

        digitalWrite(yellowLED, LOW);

        digitalWrite(greenLED, HIGH);

      }

      Delay(1000);// wait for 1 seconds before taking the next reading

}
```

4.15 FLOW CHART

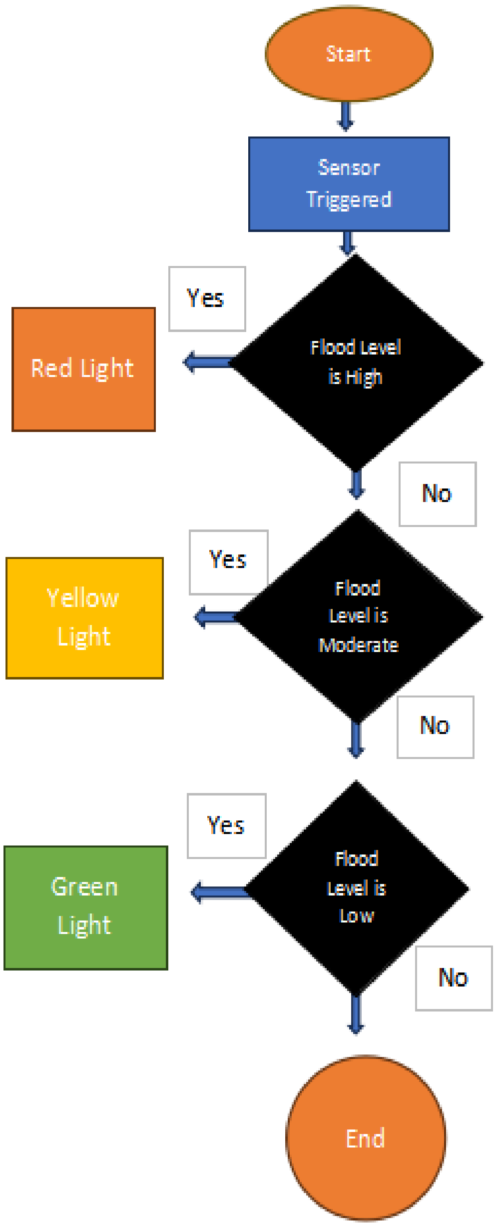

Figure 4.15: flowchart of the syste

3.16 Complete System and Description

The flood control system depends on the feedback from the ultrasonic level sensors which determines the level of the water, the system is made of one circuit which consists of inputs and outputs, the inputs part they are three level sensors connected to the microcontroller ‘‘ARDUINO UNO’’, the output is made of LEDs which are controlled by the microcontroller, each of the LEDs describe one of the level sensors.

The system based on an ‘‘ARDUINO UNO’’, the level of the water signal is received from the level sensors which used to prevent the water from exceeding its limit, and the signal is passed to ‘‘ARDUINO UNO’’ which is used to cause a beep on the LEDs if the water reaches the HIGH level. The LEDs are used to display the different levels of the water.

Chapter Four

IMPLEMENTATION AND RESULT

4.1 System Testing

4.2 RESULTS and DISCUSSION

4.2.1 RESULTS

The Flood control system is a real-time water level monitoring solution that utilizes the HC-SRO4 ultrasonic sensor and anArduino Uno microcontroller. In real-time scenario, the system serves a vital safety tool in flood-prone areas, basements, or any location where water levels need monitoring. The HC-SRO4 sensor is mounted at an appropriate position, such as near the floor or ground, and emits ultrasonic waves that bounce back after hitting the water surface.The Arduino Uno reads the time taken for the wave to return and circulates the distance to the water surface based on the speed of sound in air. By comparing the measured distance with predefined thresholds, the system determines the water level – low, medium, or high. Based on this information, the Arduino Uno activates the corresponding LED indicator: green for normal/low water, yellow for medium, and the red for high water levels. The LEDs provide clear visual indications, allowing users to take prompt action based on the detected water level. In a real-life situation, the system ensures early flood detection, providing residents with critical alerts before the situation becomes hazardous. The best position to place the sensor is close to the water surface for accurate distance measurement. The other components, resistors and LEDs, work together to control the LED indicators based on the water level detected by the sensor. The Flood Control System offers a user-friendly and effective solution, empowering individuals to respond proactively to potential flooding and safeguard lives and properties.

Chapter five

Conclusion and recommendation

5.0 Conclusion

The Flood Control system using the HC-SR04 Ultrasonic sensor and Arduino Uno provides a cost effective and reliable solution for monitoring water levels in various applications. The system uses the Ultrasonic sensor to measure the distance to the water surface, and based on the measured distance, it determines the water level (high, medium, or normal/low) and visually indicates it through the respective LEDs. This system can be deployed in flood-prone areas, basements, or any location where water levels needs to be monitored for safety and protection, countries have managed to drastically reduce flood damages through integrated water level detection, flood protection, forecasting, and warning and response actions through institutionally framed processes.

5.1 Recommendation

1. Consider using waterproof enclosures for the electronics to protect them from water damage, especially in outdoor application or flood-prone areas.
2. Implement a power backup system, such as a battery, to ensure continuous monitoring even during outages
3. Optimize the sensor's position and orientation for accurate distance measurements and reliable water level detection.
4. Add a data logging feature to record water level readings for analysis and historical data tracking
5. Conduct real-world testing and calibration to ensure the system's accuracy and reliability in different environmental conditions.

By following these recommendations, the Flood Control System can be enhanced for more robust and dependable water level monitoring in various scenarios, ultimately contributing to early Flood Control and better Flood management in real-life situations.