THEME : flood monitoring and early warning

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EXECUTIVE SUMMARY

CHAPTER ONE

For the establishment and operation of the proposed FEWS to be successful, the contribution and coordination of diverse range of relevant institutions, agencies, communities and individuals are required. These stakeholders have specific functions, roles and responsibilities for which they are accountable in the successful operation of the proposed FEWS. Following a bottom-up approach, these stakeholders include: vulnerable communities resident in the eight hydrological areas of the country; Community Based Organizations; Local, State and Federal Governments of Nigeria; Government Agencies and Institutions; the Private Sector, the Academic and Scientific Community; Non Governmental Organizations; Regional Institutions and Organizations; and International Organizations.

The concept of Flood Early Warning Systems (FEWS) and its application as a flood disaster reduction strategy is at its inception stage in Nigeria. Hitherto, the key components of FEWS such as data collection and transmission, flood forecasting, warning dissemination and communication, and emergency response were carried out by different agencies and institutions which operated independently in standalone mode. There is no coordinated monitoring of floods or established early warning systems for flood disaster reduction in Nigeria. Majority of the river systems in Nigeria do not have functional water level gages while those rivers that have stage and discharge stations are not integrated into a coordinated system. The status of hydrometeorology data collection and monitoring for flood early warning is grossly inadequate in majority of the river basins in the country.

CHAPTER TWO

The National Workshop on Flood Early Warning System (FEWS) held at Reiz Continental Hotel in Abuja between Tuesday 5th and Wednesday 6th of August 2008, cover wide ranging topics like: the causes of floods; the management of flood disasters; role of NGOs, CBOs and other stakeholders in the management of floods; socio-economic consequences of floods; capacity building for Flood Early Warning Systems.

The Workshop was divided into four (4) different Technical Sessions with a total of twelve paper presentations. The Workshop deliberated on twelve (12) papers presented by seasoned resource persons. All the twelve papers were reviewed.

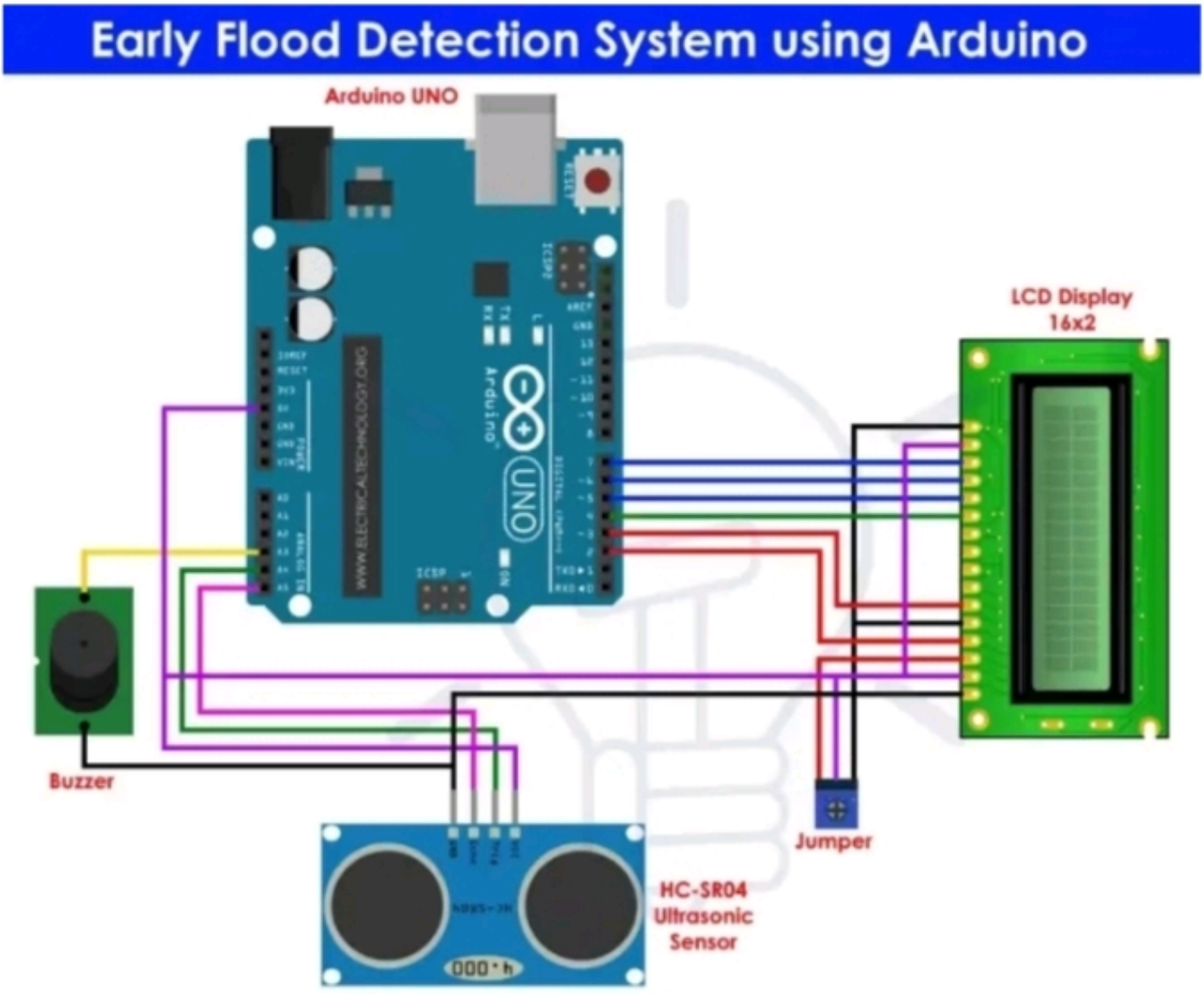
CHAPTER THREE

The framework of early warning systems consists of three phases including the monitoring of precursors, forecasting of a probable event, and the notification of a warning or an alert should an event of catastrophic proportions take place. Since the incidence of floods in the country are caused by several factors including hydro-meteorological phenomena, the successful operation of an Early Warning System in Nigeria would require an Integrated Flood Management Approach, whereby all related organizations from all sectors of the country should be involved.

Flood Early Warning System (FEWS) is an integrated package of data collection and transmission equipment, forecasting models, response plans and procedures, and human resources working together with the sole objective of empowering individuals and communities threatened by flood hazard to act in sufficient time and in an appropriated manner to reduce the possibility of personal injury, loss of life and damage to property and the environment. FEWS in Nigeria has been designed to be people-centred and integrate Knowledge of the risks faced by the society; Technical monitoring and warning services; Dissemination of meaningful warning to people at risk; and Public awareness and preparedness to act.

The design incorporates approaches employed for design and operation of Flood Early Warning Systems in the Haddington FEWS in the UK; Norwegian FEWS; and Japan's FEWS and the Flood detection and early warning systems developed in Malaysia which includes a public alert system for possible imminent flood events. The FEWS design for Nigeria focuses on monitoring the water level remotely using wired sensor network. Data is collected from the sensor using data acquisition device and channelled to the National FEWS Centre which relay the information to the public through Global System for Mobile Communication (GSM) using Short Message Service (SMS). The system ensures that the end users receive appropriate warning within suitable time interval to take effective action to save lives and minimize loss of properties.

Circuit Diagram for Early Flood Detection



Longer lead times and improved accuracy of flood forecasts require an effective use of the latest technology available in the fields of hydrology and meteorology as well as Information, Communication and Technology (ICT). The best design option for Nigeria's FEWS is for an integration of flood forecasting and early warning services that is people-centred in focus.

CHAPTER FOUR

The primary goal of this guideline is to work out modalities for the establishment and operation of Flood Early Warning Systems in Nigeria. To effectively achieve this goal the objectives of this guideline shall be to work out modalities to: Reduce the risks of flood disasters on vulnerable communities of Nigeria and thereby save lives and properties; For the establishment of FEWS as a non structural strategy for flood disaster reduction in Nigeria aimed at minimizing the damage of flood water in flood prone areas of Nigeria; and Establish an effective, integrated, cost effective and sustainable Flood Early Warning System that is institutionally manageable and technologically sound and flexible.

Among the technical challenges in the establishment of an integrated and coordinated Flood Early Warning Systems in Nigeria includes: Availability of hydrological and meteorological data; Diverse topography and geology; Sediment loading problems in river systems and its effects on long term operation of the FEWS; Changes to channel geometry variability; Adaptation of the FEWS for the diverse types of flooding experienced in Nigeria; and Willingness of the Telecommunications service providers to participate in the establishment and operation of the FEWS without unreasonable financial motivations that will kill the system right from inception.

Some institutional challenges to the establishment and operation of FEWS in Nigeria include: Inadequacy in existing institutional capacities and the bureaucratic tendencies of the institutions to interoperability highly essential for timely data sharing and dissemination which is the heart of the FEWS; Inadequate flood hazard assessments capability; Effective monitoring and evaluation of the Flood Early Warning Systems; Cooperation between Government agencies; Private sector involvement; Community ownership and interest; Financial sustainability; and Economic incentives.

Full Source Code:

```
#include
LiquidCrystal lcd(2,3,4,5,6,7);

float t = 0;
float dist = 0;

void setup()
{
 lcd.begin(16,2);
 pinMode(18,OUTPUT); //trigger pin
 pinMode(19,INPUT);  //echo pin
 pinMode(20,OUTPUT); //buzzer
 lcd.setCursor(0,1);
 lcd.print(" Water Level Detector");
 delay(2000);
}

void loop()
{
 lcd.clear();
 digitalWrite(20,LOW);
 digitalWrite(18,LOW);
 delayMicroseconds(2);
 digitalWrite(18,HIGH);
 delayMicroseconds(10);
 digitalWrite(18,LOW);
 delayMicroseconds(2);
```

```
 t=pulseIn(19,HIGH);
 dist=t*340/20000;

 lcd.clear();
 lcd.setCursor(0,1);
 lcd.print("Distance : ");
 lcd.print(dist/100);
 lcd.print(" m");
 delay(1000);

if(dist<40)
{
 digitalWrite(20,HIGH);
 lcd.clear();
 lcd.setCursor(0,1);
 lcd.print("Water level is rising. Kindly eva
 delay(2000);
}
else
{
 digitalWrite(20,LOW);
 delay(2000);
}
}
```

CHAPTER FIVE

Since Flood Early Warning Systems begin with data collection and transmission. Rainfall is to be measured with automatic rain recording gauge which will record the time at which a known volume occurs. From this time series, the rate of and cumulative depth of rainfall can be calculated. The river level (in case of the river flood plain) and/or the tidal level (in case of the coastal flood areas) are to be monitored using simple automatic recording sensor mechanism without direct contact with the water surface. However, real-time precipitation data from satellite sources would be employed in monitoring and forecasting rainfall using remote sensing. In order to increase the lead time, rain forecasts would be derived from statistics. Wireless data-transmission would be used for online transmission of both the data measured and those obtained from satellite sources.

The major characteristics of rainfall that affect the amount and rate of runoff which are important for this Flood Early Warning System (FEWS) model includes: intensity; depth; distribution over an area (spatial); and, distribution over time (temporal). There are a number of physical characteristics of catchments that affect the amount and/or rate of runoff they generate. Some of these characteristics vary with the season and the type of management practices used. The impact of an individual characteristic depends on the size and shape of the catchment.

Due to the importance of having a simple, reliable and cost effective system, the Flood Early Warning System Model is to be based primarily on the characteristics of rainstorms likely to cause floods. Such characteristics of importance includes extreme meteorological event in form of approaching rain bearing storms of tropical cyclone, rainfall intensity/amount indices, and the anticipated water levels of river channels.

The typical model entails the observation and prediction of flood stage. However, the lack of existing reliable hydro-meteorological data creates difficulties in establishing empirical relations which could directly be employed in developing a scheme. Hence, an isolated event model approach which employs information on rainfall characteristics and its routing through a linear reservoir is prescribed with analysis of the catchment response. The model assumes that runoff occurs as predicted by the contributing area theory which requires that all the rain falling on the saturated portion of the catchment will create runoff but no runoff will occur immediately from the remainder.