UNDERGROUND GUTTER DRAINAGE MONITORING USING GSM

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Abstract:*Water is the main contributor to the wear and damage of low volume roads. During rainy season underground gutter creates major problem for living beings. The underground gutter gets overflow during rainy season. The water becomes stagnant at the bottom of the gutter, when overflow occurs which is harmful to human beings. To overcome this we have proposed a system to address the problem.The alert system consists of water level indicator and Force sensor, GSM modem andArduinoUNO(ATMEGA328)microcontroller. The water level of the gutter is categorized into three levels (Low level, Medium level, High level). The sensor is used to find the level of water. The sensor will alert the corporation when the flow of water is high. The location co-ordinates are received from the GPS module. The location information transfer to the corporation for identifying the problem by using GSM module.*

1. Introduction

Drainage is defined as the infrastructure for drying the land from the excess and unutilized water, rainwater and waste water. The type of drainage channel can be natural channel or constructed channel. In an urban, drainage channels built to control the surface water due to rain, waste water, so it does not disturb the activities and the country's facilities and property in the community.

Drainage conditions should be monitored in order to maintain its proper function. In fact, not all areas have drainage monitoring team. It leads to irregular monitoring of the drainage condition. The irregular monitoring has contribution on the clogging of the drainage that imply to the siltation which trigger flooding in the neighbourhood. Manual monitoring is also inefficient. It needs a lot of

dedicated persons who are only able to record limited report with low accuracy. These weaknesses lead to the slow handling for problems in drainage.

Wireless Sensor Network (WSN) is a monitoring technology which consists of node sensors that spread and coordinated use of a wireless network system. Each node has data processing (microcontroller),GSM receiver, power supply system (battery or solar cell), and involves one or more sensors .WSN systems have a higher level of efficiency than wire line network system in terms of cost, flexibility and reliability and is expected to replace the hybrid technology (wire line and wireless) in the coming years. WSN technology can be applied in many fields that require monitoring data regularly. An example is the environmental experts which monitor the habitat of a region, monitoring the dry fields of fire (fire bug), preventive maintenance on oil tankers using sensor network support, or observation of mountain environments that have the seismic parameters that can remotely monitor the level of activity of the volcano. Urban areas can also utilize this technology as in,WSN can monitor air pollution, strength building, flood hazards, the level of hilarity (noise) and the video feed, where everything can be observed through GSM.

In an urban area, drainage has an important role in the prevention of flood danger. In these studies emphasize about the control simulation of sewerage system for monitoring sensors and instrumentation drainage conditions. While research related to the implementation of a wireless sensor network (WSN) in the management of the drainage system has not been done. This paper will discuss the design of drainage systems to monitor conditions at some point in drainage by wireless sensor networks. Some node sensors are deployed at some point will be communicated and will transmit the data about the condition of drainage to server. The parameters will be monitored are water levels in drainage, water discharge and rainfallconditions around the drainage area.

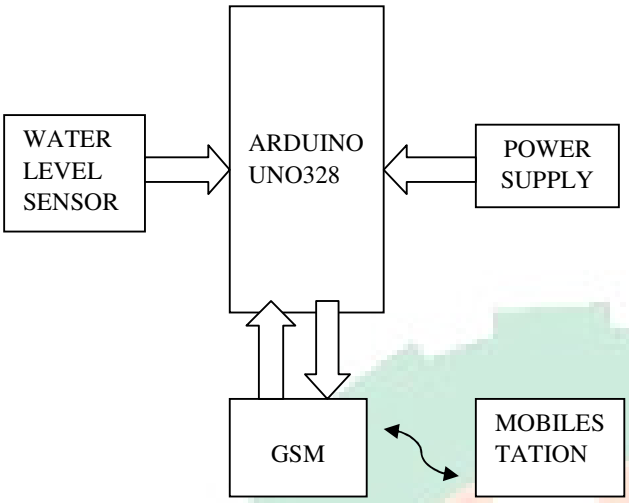

Figure1.Block Diagram of Drainage Monitoring System

2. METHOD

Wireless sensor network is a network that communicates some sensor nodes that are implemented in some areas. Each sensor node consists of a sensor unit, a communication unit and a power unit. It is important in wireless sensor

Design of drainagemonitoring system consist of several stages are:

a. Design of Sensor nodes:

The important component on sensor nodes are sensors unit, processor, wireless communication unit, and supply units. Sensor has a function to sense physical quantities to be measured. Wireless communication unit for communicating sensor nodes. Supply units give a power for sensor nodes. The processor is an important part that willThe type of sensor also affect to reliability of sensor nodes. The sensors must weatherproof and resistant to noise because the sensor will be placed outdoor. The wireless communication unitcan be used isGSM (Global system for Mobile Communications).

b.Design of Communication units:

In wireless sensor network, the type of network topology that can be used are star, ring, bus, tree, mesh and fully connected topology. Network topology that used in this design is bus topology.

Processor is placed in an ArduinoUNO board which is an open-source electronic prototyping platform to implement software into the hardware.

Sensor nodes will be connected each other via wireless communication using radio frequency module. Communication between sensor nodes ended at gateway. From the gateway the data transmit to the server via GSM (Global System for Mobile Communication) to the corporation.

c. Design of Layout for sensor nodes:

Layout of sensor nodes must consider to important thing such as: location sensor nodes must represent drainage conditions, distance between 2 sensor nodes must in communication range of radio frequency module that be used, connections between 2 sensor nodes must between the closest distance of sensor nodes because of minimizing delay and noise, location of gateway must have good access to GSM signal and the position of gateway in middle of sensor nodes.

3. RESULT AND DISCUSSION

It has been explained that wireless sensor network consist of sensor unit, communication units and supply unit. The working principle of wireless sensor networks can be described as the sensors collect data sensing that will be transmitted by the processor to the gate way. At the gateway, data will be processed and sent to the corporation through GSM. When the sensor device report parameter exceeds the specified limit, the server will give the command to the controller to decrease or increase the performance of electrical equipment. This section will discuss about type of sensor that be used, processor, communication module, layout for sensor nodes, and general design for data base for drainage monitoring system.

3.1 Sensor Unit

Based on drainage monitoring guidelines, the monitoring parameters are water level and water discharge. So the sensor that we need are water level sensor and velocity water flow sensor. There are several types of water level sensor include float sensor. Each type has its advantages and disadvantages for collecting water leveldata.That signal will be count to determine value of water level. The tipping bucket sensor is not as accurate as standard rain guage, but it is quite appropriate for drainage monitoring system. The advantage of the tipping bucket sensor is easy to obtain character of the water.

Water level sensor is used to determine the water level and contributes to calculation of water discharge. If the water level increases while the rainfall and water discharge normal it means that occurssiltations in the channel. The type of level sensor that used is a piezoresistive sensor type of GTL500 TM . This sensor has special structure and application. It has high accuracy. It is widely used in coastline monitoring, sewage treatment, water saving irrigation, water diversion project etc.

Water discharge is obtained by multiplying the velocity of water flow (V) by wet cross section area (A). Measurement of velocity of water flow is done using current meter. Wet cross section area is calculated use hydraulic formula. There are three types of cross section channel drainage that is trapezoidal, rectangle, and circle. Trapezoid shape used for irrigation or drainage channels, because it has the shape of a natural channel, where the slope of the ridge to adjust the angle of the natural slope of the land used for the channel. Rectangle used for used for drainage channels through the narrow land. Circle is usually used at a crossroads .The high variable (‘y’ at rectange and trapezoid type, ‘d’ at circle type) obtained from water level sensor result.

$$Q = V \times A$$

Q = water discharge (m^ 3/s)

V = water flow (m/s)

A = wet cross section area(m^2)

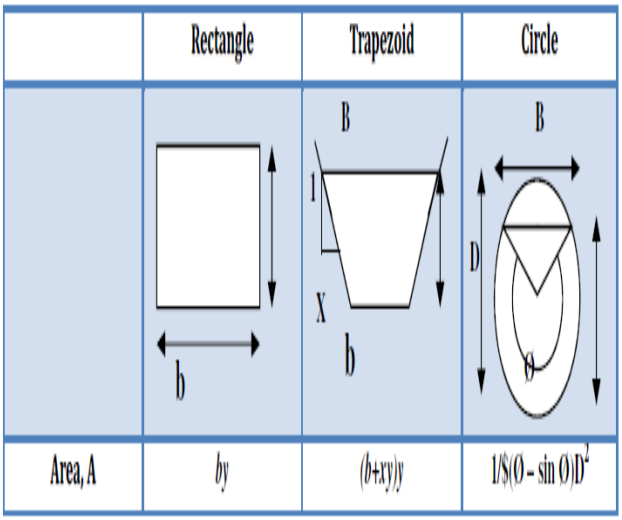

Figure2.Formula for Wet Cross Sectional Area

Hardware on the node sensor includes sensors unit, signal conditioning, processor, GSM modules and supply units. The processor that used is microcontroller ATMega328. The consideration use ATMEGA 328 is easy to use, less power or energy consumption, and efficient cost. This module require minimal power and provide reliable delivery of databetween remote device.

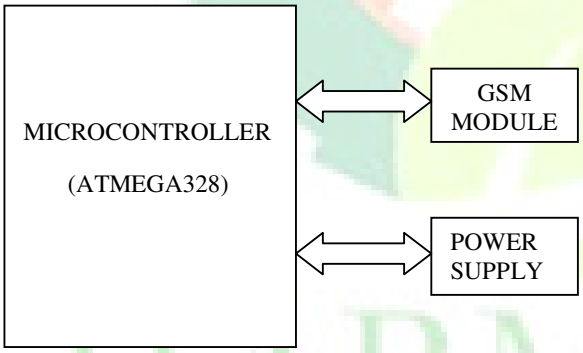

Figure3.Block Diagram for gateway sensor

3.2 Layout for Sensor Nodes

It has been explained that location sensor nodes must represent drainage conditions. From the topography area we must defined catchment area (zone rainwater) . There are shown 3 catchment areas. Furthermore, the drainage direction is defined as shown in figure. In the drainage system there are three channels, namely tertiary, secondary and primary channels. Tertiary channel drain rainwater from the catchment area to the secondary channel. Secondary channel drain rainwater from tertiary channel to primary channel, while the primary channel drain rainwater from the secondary channel

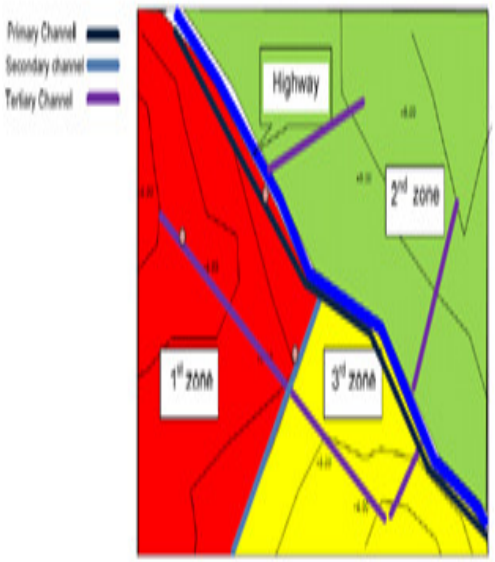

Figure4.Condition of Topography and Drainage Channel

Installation of force sensors and water level sensors will be done at certain points in each type of the channel. While rainfall sensors will be placed around the tertiary channels in order to determine the volume of drainage water in the region. And the Force sensor is used to determine the velocity of the water flow in that drainage.

Floating sensor is used to measure the level of the water in the drainage by means of electrodescontacts with the water in the drainage.

Figure5.layout for the Node Sensor

There are 6 node sensors where each adjacent node sensors will communicate with each other. While the node sensor number 3 alsoacts asa gateway. Sensor nodes will transmit the data to the closest sensor node to be forwarded to the sensor nodes that also functions as a gateway. Furthermore, the gateway will send the data to the Corporation. Data in the form of water level, water discharge and overflow for each region will be sent to the corporation.

3.3 General Design of Data base System

Database in this research will be used to manage data for monitoring of drainage. So goal of this drainage datamanagement systems is to identify drainage problems in each region. So the system facilitate the monitoring team for observing and recording the drainage conditions in each region. Activities to be undertaken in the management of this data include several stages, based on software development activity (SDLC – Software Development Life Cycle). The stages consist of the following .

1. Planning / Requirements

At this stage the activity is gathering information and data necessary to identify specification business rule and business process. In this stage, data will gathering using observations and interviews with users of the system.

2. Analysis and Design

The activity in this stage is to analyze all the data, information and business processes that are the result of the previous stage. The analysis is done by identifying objects or entities, attributes and relationships will be managed in the drainage system. Then conducted data modelingusing entity relationship diagram design (ERD) to see the possibility of the implementation of the system. A good ERD can affect the easy of accessing and storing data in the database.

3. Implementation

At this stage of the modeling data that has been generated from the previous stage, will be transformation into the form of a table, and then implemented using specific DBMS (Database Management System) i.e SQL server or oracle Database.This drainage system information will be displayed in the form of message.

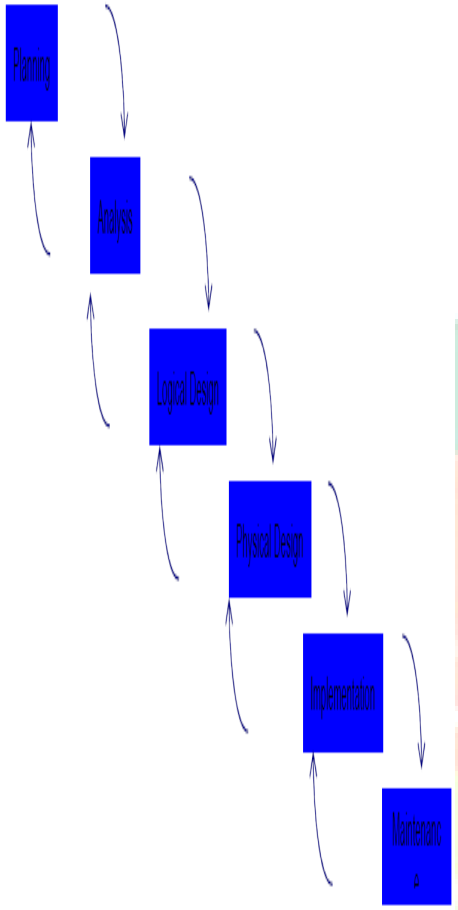

Figure6.Database Development Activity

4. CONCLUSION

Wireless sensor network is a network that communicates some sensor nodes are implemented in some areas. Each sensor node consists of a sensor unit, a communication unit and a power unit. Design of drainage monitoring system based on wireless sensor network consist of several stages are: design of sensor node, design of communication unit, design of lay out sensor node, and design of data base system. The important component on sensor nodesconsist of sensors unit, processor, wireless communication unit, and supply units. In the drainage monitoring systems, the sensors are force sensor, water level sensor. Communication between gateway and corporation use GSM module.

Some considerations in lay out of the sensor nodes are: location sensor nodes must represent drainage conditions, distance between 2 sensor nodes must in communication range of radio frequency module that be used, connections between 2 sensor nodes must between the closest distance of sensor nodes because of minimizing delay and noise, location of gateway must have good access to GSM signal and the position of gateway in middle of sensor nodes. Suggested future works are builds, analyze and evaluate designs that have been created. The results of the analysis and evaluation will be input for building drainage systems monitoring more reliable.

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