Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT-BASED REAL-TIME DRAINAGE MONITORING SYSTEM

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

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DEDICATION

To my beloved mother Mrs.Thuvalarasi a/p Rajoo and my father Panner Selvam a/l Mani, my supportive supervisor Ts. Dr. Ida Syafiza Binti Md Isa, my faithful panels, lecturer of FTKEE, and my friends who strongly supported throughout thick and thin.

ABSTRACT

Nowadays, technologies are rapidly advancing in this world, including the type of monitoring system used. In addition, the evolution of the Internet of Things (IoT) has made people's life more convenient and practical where it supports everyone to be connected to any things, and anywhere, via the Internet. It has been reported that the current drainage system in most of the countries is still using manpower which may expose them to many hazards and accidents. Therefore, monitoring the status of the drainage from time to time is very crucial to avoid accidents to happen. Several researchers have focused on developing drainage monitoring systems, however, most of the system are using GSM module to send the monitored data to the control room which introduced latency. Therefore, the purpose of this work is to develop an IoT-based Real-Time Drainage Monitoring System to monitor the drainage system. In this work, the proposed system is designed to detect the depth of the water, the level of gas concentration at the drainage area, and the flow rate of the water flow in the drain using a laser sensor, gas sensor, and flow meter sensor, respectively. Besides, the system is also equipped with a GPS module to locate the location of the monitored area. For monitoring purposes, the system is integrated with the Blynk server application where all of the monitored data including the depth of the water, gas concentration, and the flow rate of water in the drain will be stored in the cloud server via WiFi connection. In addition, a notification will be sent out to the in-charge person if any of the sensors exceed the threshold value. The proposed system has been tested and the results show that the system has high reliability and measured and the actual reading has high accuracy with a margin error of 3%.

ABSTRAK

Pada masa kini, teknologi berkembang pesat di dunia ini, termasuk jenis sistem pemantauan yang digunakan. Di samping itu, evolusi Internet of Things (IoT) telah menjadikan kehidupan orang lebih mudah dan praktikal di mana ia menyokong semua orang untuk dihubungkan dengan apa sahaja, dan di mana sahaja, melalui Internet. Telah dilaporkan bahawa sistem saliran semasa di kebanyakan negara masih menggunakan tenaga kerja yang dapat mendedahkannya kepada banyak bahaya dan kemalangan. Oleh itu, memantau status saliran dari semasa ke semasa sangat penting untuk mengelakkan kemalangan berlaku. Beberapa penyelidik telah menelitikan diri pada pengembangan sistem pemantauan saliran, namun, sebagian besar sistem memiliki beberapa kesalahan seperti penerapan gsm dalam sistem yang memberikan data lambat yang akan mempengaruhi pengiriman data waktu nyata ke ruang kontrol masing-masing. Oleh itu, tujuan kerja ini adalah untuk mengembangkan Sistem Pemantauan Saliran Masa Nyata berasaskan IoT untuk memantau sistem saliran. Dalam ini, sistem yang dicadangkan dirancang untuk mengesan kedalaman air, tingkat kepekatan gas di kawasan saliran, dan kelajuan aliran air di longkang menggunakan sensor laser, sensor gas, dan sensor meter aliran , masing-masing. Selain itu, sistem ini juga dilengkapi dengan modul GPS untuk mencari lokasi kawasan yang dipantau. Untuk tujuan pemantauan, sistem ini disatukan dengan aplikasi pelayan Blynk di mana semua data yang dipantau termasuk kedalaman air, kepekatan gas, dan laju aliran air di longkang akan disimpan di internet melalui sambungan WiFi. Sebagai tambahan, pemberitahuan notifikasi akan dihantar kepada orang yang bertanggungjawab sekiranya ada sensor yang melebihi nilai ambang. Sistem yang dicadangkan telah diuji dan hasilnya menunjukkan bahawa sistem ini mempunyai kebolehpercayaan yang tinggi dan tepat dengan kesalahan margin 3%.

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1. % - Percentage
2. ° - Degree
3. ‘ - Prime
4. “ - Double Prime

LIST OF ABBREVIATIONS

API - Application Programming Interface
CMOS - Complementary metal-oxide semiconductor
CO - Carbon Monoxhide
CPU - Central processing unit
CRs - Cognitive Radio
DHT - Digital Temperature and Humidity
DOMS - Drainage Overflow Monitoring system
DSP - Digital signal processing
GND - Ground
GPS - Global position system
GSM - Global System for Mobile
HTTP - Hypertext Transfer Protocol
IDE - Integrated Development Environment
IOT - Internet of Things
LCD - Liquid Crystal Display
LUA - High-Level Programming Language
MCU - Micro controller Unit
NET - Network Enterprise server
NETPI - Network Analyser
NFV - Network Function Virtualization
PIC - Perifral Interface Controller
PPM – Parts Per Milloin
RF - Radio frequency
RFID - Radio-frequency identification
SD-WSN - Software Defined Wireless sensor network
SPAD - Single Photon Avalanche Diodes
SPI - Serial Peripheral Interface
TCP/IP - Transmition Control Protocol/ Internet Protocol
TOF - Time-of-Flight
UART - Universal Asynchronous receiver-transmitter
VCC - Voltage Common collector
VNC - Virtual network computing

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CHAPTER 1

INTRODUCTION

1.1 Background

The Internet of Things (IoT) is a combination of sensors, software, and other technologies embedded in objects that connect and exchange data with other devices over the internet. A study in [1] said that by applying intelligence in everyday objects, they turned into smart devices and can be controlled from anywhere in the world.Many IoT-based systems has been developed for monitoring purposes which include home automation system, remote health monitoring system and emergency notifications for medical and healthcare systems, agriculture monitoring system that can control the water pump anywhere and environmental monitoring. However, it has been reported that, currently, the drainage system in most of the countries is still using manpower for cleaning and managing purposes [1]. Hence, the workers are exposed to hazardous gaseous around the drainage area which may lead to underground workers' death. Therefore, monitoring the real-time condition of the drainage system is very crucial to avoid any accident. In this work, an IoT-based real-time drainage monitoring system has been developed using an Arduino microcontroller with the aim to monitor the depth of the water, the gas concentration, and flow rate of the water in the drainage system. The real-time monitored data will be sent to the cloud via WiFi using the Blynk application. Also, the proposed system is equipped with a GPS module to locate the location of the monitored drainage area and a notification message will be sent out to the in-charge person when an emergency is detected i.e. sensor detected value that exceeds the threshold.

1.2 Problem Statement

A flood is a disaster caused due to a clogged drainage system [2]. Recently, it has been reported that the flash flood that happened in Kuala Lumpur, is due to the poor service maintenance of the drains and irrigation canals. The poor service maintenance of the drains and irrigation canals has resulted in the exposure of toxic gases due to the decomposition of organic household or industrial waste. In addition, the flash flood also leads to a rise in mosquitoes, a foul odor, etc. Therefore, the development of a smart drainage monitoring system is important to prevent flooding. Many researchers have focused on developing the drainage monitoring system. However through the previous research, certain disadvantages can be found which require human interaction at times to obtain the results from the system, data recorded is not in real-time, and limited sensors. Therefore the proposed project overcomes the disadvantages of the existed project and will be a reliable device to assist the challenged workers.

1.3 Project Objective

The objectives of this work are as follows:

a) To develop an IoT-based real-time drainage monitoring system, to monitor the depth of the water, the level of gas concentration, and the flow rate of the water for blockage detection in the drain using Arduino.

b) To develop a data logging system to record real-time monitored data for monitoring purposes.

c) To evaluate the performance of the developed prototype in terms of its reliability and accuracy compared to the measured value.

1.4 Scope of Project

The scope of the projects prioritizes the detection of the water flow rate, the depth of water level, and the presence of gas concentration through using a portable device that can produce real-time data using the presence of IoT. The proposed system is targeted to be used as one of the smart cities applications where wireless internet connection is unlimited. Since the project is focusing on flow rate, using water flow sensors helps to calculate the volume of water flowing through the system.

The project also focuses on monitoring the gas concentration value in parts per million(ppm) at the drainage environment therefore a Gas Sensor is MQ-5 sensor is also added to the system for monitoring purposes. Since the MQ-5 gas sensor has a high sensitivity to Methane, Propane is a suitable sensor for the current environment. The TOF10120 sensor is a range module camera system that measures the round trip traveled by the light produced to determine the distance between the camera and the subject for each point of the image with time-flight techniques. Through the laser sensor, the data being recorded is the height water level. A GPS is added to this project so that it gives flexibility for the respective authority to detect the location of the system. Each GPS satellite sends a signal to the GPS receiver. The satellites transmit the same time at which the signals are sent. All the information mentioned above is sent to the Blynk server application through wifi for recording purposes in real-time. The data recorded from the server is being recorded every 5 minutes interval time and tabulated to get an average reading.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this part chapter, thorough literature research has been conducted based on the previous works to better understand the research problem being studied. A detailed discussion has been done and analyzed on the relationships of each work obtained from various authors that are relevant to this project.

2.2 Concept of IOT

According to the IoT agenda, Kevin Ashton of Procter & Gamble created the term "Internet of Things.". Through his founding of radio frequency identification (RFID) where this would allow computed to manage a person's belongings. Back then the minimum goal of IoT is the installation of short-range mobile transceivers into a variety of common items and to provide new forms of communication between humans and machines. A study has been conducted to support this claim by [1] to introduce the Internet of Things (IoT) as a wide cultural phenomenon. Their paper also recommends two techniques for developing new business models based on IoT and concludes with a discussion of how far the future of IoT can be anticipated. The elements of IoT can be represented in Table 1.1 below.

Table 2. 1 Elements of IoT

Technological Aspects	Hardware	Wireless devices (such as computers, smartphones, RFID tags, and wireless sensors) are used to connect physical objects to the Internet of Things (IoT) and enable communication across the network.
	Software	Built software applications to input value in a certain groups of customers and utilities for an end to end IoT user applications
	Networking	Different networking technologies allow us connecting from one point to another point through the internet and satellite communication.
	Intergrated manifesto	A cloud-based, integrated platform that allows interaction and easy compatibility between multiple hardware, software, and networking aspects.
	Quality	Operational guidelines require the design of emerging Iot components and ensure their compatibility.
	Data	Data created in real-time by IoT nodes that are constantly broadcasting their properties through the network (for example, a temperature sensor transmitting room temperature).
Physical environment	Human objects	Humans experiencing with the IoT wireless devices such as smartphones, health sensors, etc.
	Objects	Cars, parcels, and animals are examples of physical objects that can interact and share through a network.
	Surrounding environment	Humans and physical space can communicate with one another, such as at a vehicle park with an integrated RFID card reader.
Socio-economic	Customers	Specific IoT applications, such as smart home systems, target individual consumers or companies.

	Department of Organization	The organisations in charged of developing, publishing, and enforcing IoTrelated regulations.
	Associations of companies	Companies that are responsible setting standards and guidelines that facilitate IoT.
	Consumer privacy groups	Protecting customers from security and privacy problems as a result of IoT applications and similar technologies
	Entrepreneurs	Intelectual business person engaging in entrepreneurship and intrapreneurship using IoT.

Based on research done by [2] says that their paper presents the Internet of Things, including statistical and architectural trends, application cases, problems, and future possibilities The author also gives an overview of the developing 5G-IoT framework. Some of the IoT technologies are SD-WSN, NFV, and smart radios are all examples of software-defined wireless sensor networking (CRs). The authors say that IoT offers many business and carrier opportunities. Figures 2.1 and 2.2 below briefly describe the future of IoT.

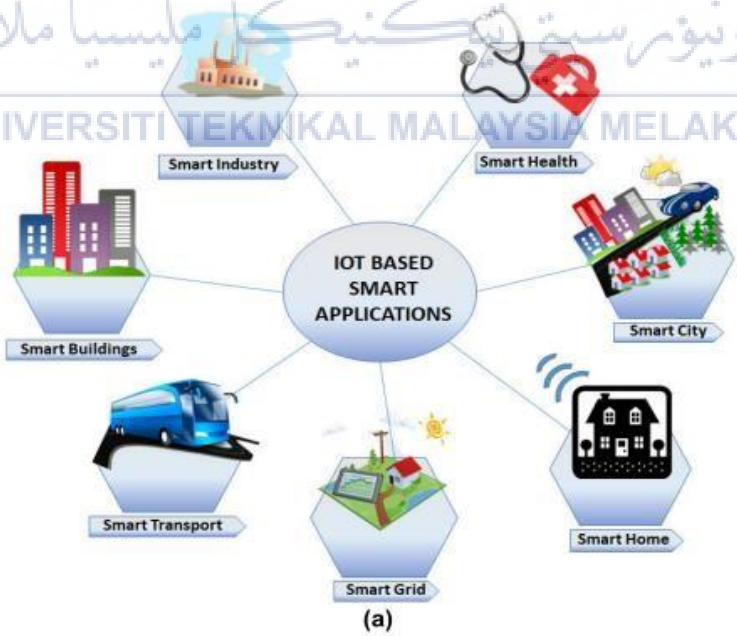

Figure 2. 1 IoT based smart applications (Kinza Shafique and Bilal A. Khawaja)