School

of

Electronics and Communication Engineering

Mini Project Report

on

SMART WATER MANAGEMENT SYSTEM

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CERTIFICATE

This is to certify that project entitled **Smart Water Management system** is a bonafide work carried out by the student team of **"Husen Mulla 01fe16bec079, Mohd Adil Baig 01fe16bec099, Ishwar Malawade 01fe16bec080, Sachin N B 01fe16bec154"**. The project report has been approved as it satisfies the requirements with respect to the mini project work prescribed by the university curriculum for BE (V semester) in School of Electronics and Communication Engineering of KLE technological University for the academic year 2018-2019.

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-The project team

ABSTRACT

Water is one of major requirement for human survival. Conservation and management of the resources must be given at most priority. The demand for water supply is ever increasing. To satisfy the water demand of huge population a smart water management system plays major role. The implementation of this water management system is done using ARM7 LPC2148. This system is integrated with collection of huge real time data, analyzing data, decision making and demand prediction. Pre-intimated water distribution, water billings are made online and a forum is made between water distributor and user through android application. Data collected from highly populated area is analyzed and the data patterns are studied using real time machine learning algorithm helps to take the quick decision. Leakages are detected by monitoring the water flow. The electronic valves are controlled through data present in cloud which is collected from android application. Thus, a sensitive system is built to overcome drawbacks of current water distribution system.

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Chapter 1

Introduction

In this section motivation for the project, objectives of the project, problem statement and organization of the report is explained.

1.1 Motivation

More than 90 percentage of the urban population has access to drinking water and more than 60 percentage of the population has access to basic sanitation. No Indian city receives piped water 24 hours a day, 7 days a week. Piped water is never distributed for more than a few hours per day, regardless of the quantity available. Less than 50 percentage urban population has access to piped water. The Non Revenue Water (NRW: due to leakages, unauthorized connections, billing and collection ineciencies, etc.) is huge, estimated between 40-70 percentage of the water distributed. Operations and maintenance cost recovery through user charges is hardly 30-40 percentage. Poor managerial and financial autonomy, limited accountability, weak cost recovery, perverse incentives and limited capacity has led to poor services to customers across the country. Urban India is at the bottom of most international measures of performance. The traditional water distribution systems require periodic manual intervention for both metering and maintenance makes it inconvenient and often least eective. Current system failed to maintain any record associated with distribution time or quantity of water to be distributed. Current water distribution system has three independently working units .First one is pumping station where water from reservoirs is pumped to domestic areas. Second one is filtration unit where standard water quality is maintained in water treatment plant. Third unit is water distribution system through which water distributed to all areas of city .

The major problems in water supply system are leakage or wastage of water. A lack of data and analysis capabilities is a problem when there is an increasing need to reduce leakage and operational ineciencies while providing an adequate water supply. The present system is manually control for that the person must visit the location of each area water control valve and open and close the valve manually for that particular area in city. According to municipal water supply rules each area has some time span for water supply. The time of each substation is distributed accordingly to all the houses that they get equal amount of water. As soon as the time limit is reached the device turns o the valve for that particular area.

1.2 Objectives

- Huge data collection of water usage.
- Demand prediction.
- Optimized water distribution.
- Reduce unaccounted water loss.
- Creating common platform for user and distributor to improvising the system eectiveness.
- Online water billing.
- Managing crucial conditions.

1.3 Literature survey

An Internet protocol version 6(IPv6) network connected internet of things design is used for real-time water flow metering and quality monitoring. This prototype implementation uses Constrained Application Protocol for monitoring and control approach which supports internet based data collection [1]. Water Wise uses a combination of model-based prediction and data stream analysis as a basis for its decision support tools. The primary data source is a wireless sensor network (WSN) that is deployed on the pipes within the distribution system, providing on-line updates of the hydraulics and water quality. The increase of deployment density, number of parameters and online data collection enabled by deploying the Water Wise WSN allows a water utility to have a more detailed picture of the water distribution system across a variety of important applications, such as leak detection, water quality monitoring, on-line hydraulic calibration[2]. The supervisory control and data acquisition (SCADA) system implemented to the central dispatching unit manages the data communication with all the remote terminate unit (RTU) and programmable logic controller (PLC), stores the received data from the measuring point and from the pumping stations and oer to the operator advanced analysis functions as well as the remote control of the main technological parameters [3]. Finding the leakage point is a tedious and time consuming using current method. Therefore, a more eective water monitoring system is needed in order to reduce water leakage eciently. Thus a wireless sensor network (WSN) is deployed in the local region and monitoring water flow, pressure and vibration at a large number of locations [4].

1.4 Problem statement

Design demand driven smart water management system for optimized water distribution and leakage detection.

1.5 Organization of the report

Following are the chapters that explain the detailed study done on the topic and the process done to select the suitable design required.

Chapter 1:
In this section motivation for the project, objectives of the project, problem statement and organization of the report is explained. which helps in selecting the suitable modules to obtain different alternate modules and select the suitable design.

Chapter 2 :
This section includes the morphological chart, design alternatives which helps in selecting the suitable modules to obtain different alternate modules and select the suitable design.

Chapter 3 :
This section explains the Implementation details which includes White box, Algorithm and flow chart. This gives us the overall architecture of the system and gives the way of approach and order of operation to the problem.

Chapter 4 :
In this section optimization techniques are briefly explained and selection of the techniques is justified.

Chapter 5 :This section the obtained results are discussed.

Chapter 2

System design

This chapter includes functional block, morphological chart, alternative designs and selection of final design.

2.1 Functional block diagram

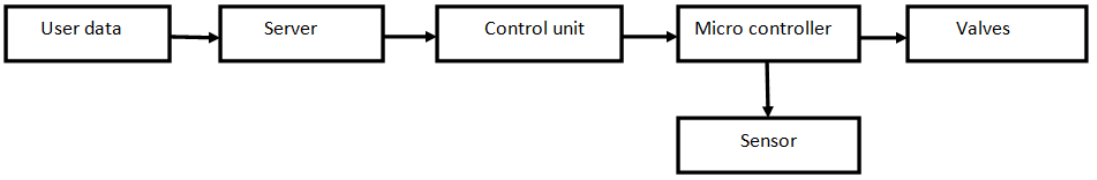

Figure 2.1: Functional block diagram

The above figure 2.1 represents the functional block diagram of the system.

2.2 Morphological chart

Components	Working principle 1	Working principle 2	Working principle 3
Micro controller	ARM cortex 3	Raspberry-pi	8051 Microcontroller
Valves	Electronic valve	Electronic valve	Solenoid 2 way valve
Pressure sensor	Ultra sonic	Gravity water pressure sensor SKU:SEN0257	Water pressure sensor G1/4
Water supply duration	Every week 6 hours	24 Hours	Daily 2 Hours
Leakage	Comparison of water being distributed with water tank	YH-602F Underground Water leakage detector	Moisture leak sensor isb02
Storage data	Amazon cloud	Amazon cloud	Hard disk
Data analysis	Using machine learning algorithm	Using machine learning algorithm	Manually
Water distribution method	Based on user data from cloud	Manually	Manually

Table 2.1: Morphological chart

The above table 2.1 represents the morphological chart in which different product functionalists are achieved through different possible solutions.

2.3 Design alternatives

The following figures represents the alternative designs based on different working principles.

2.3.1 Alternative design 1

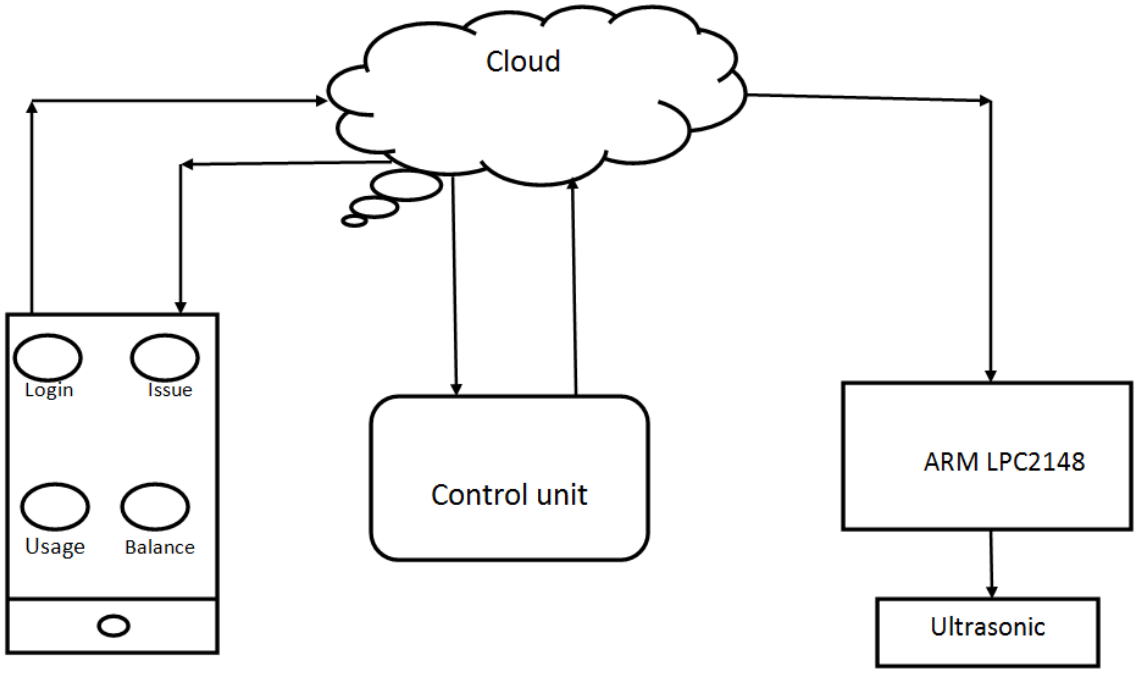

Figure 2.2: Alternative design 1

The above figure 2.2 represent an alternative design 1 in which water is distributed based on the user data provided through the android application. This system uses ARM LPC2148 micro controller and ultra sonic sensor is used for leakage detection.

2.3.2 Alternative design 2

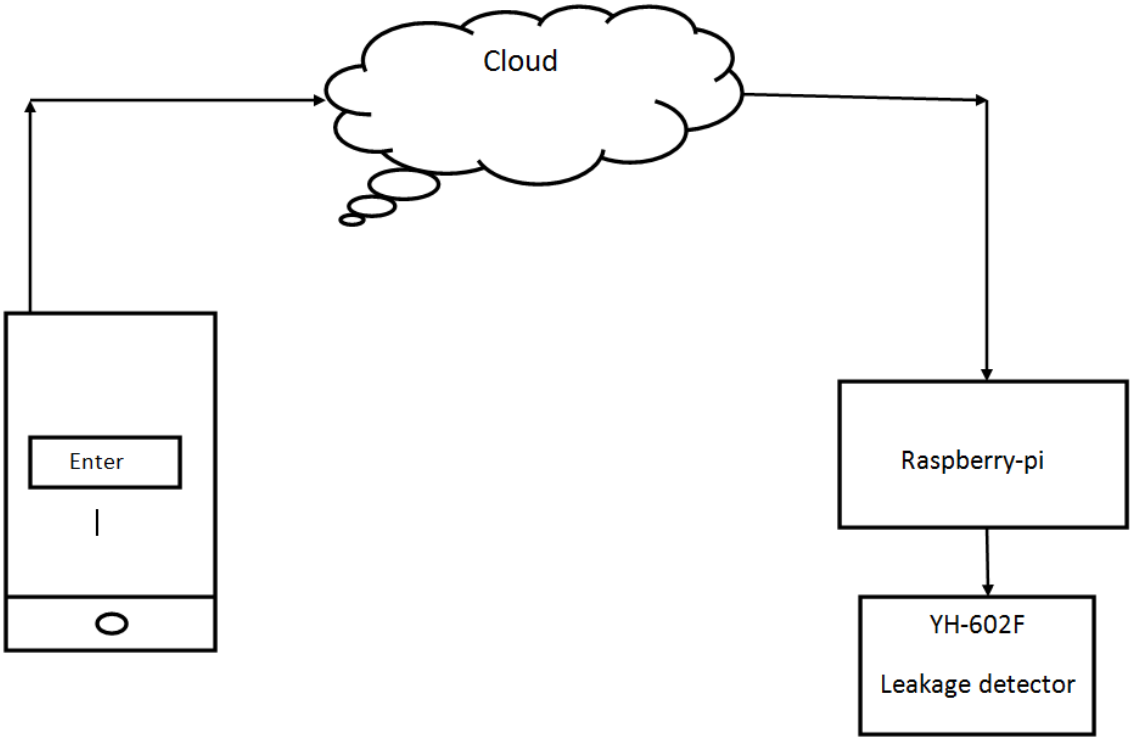

Figure 2.3: Alternative design 2

The above figure 2.3 represent an alternative design 2 in which water is distributed based on the availability of water in the reservoir. This system uses Raspberry-pi micro controller and YH-602F sensor for leakage detection.

2.3.3 Alternative design 3

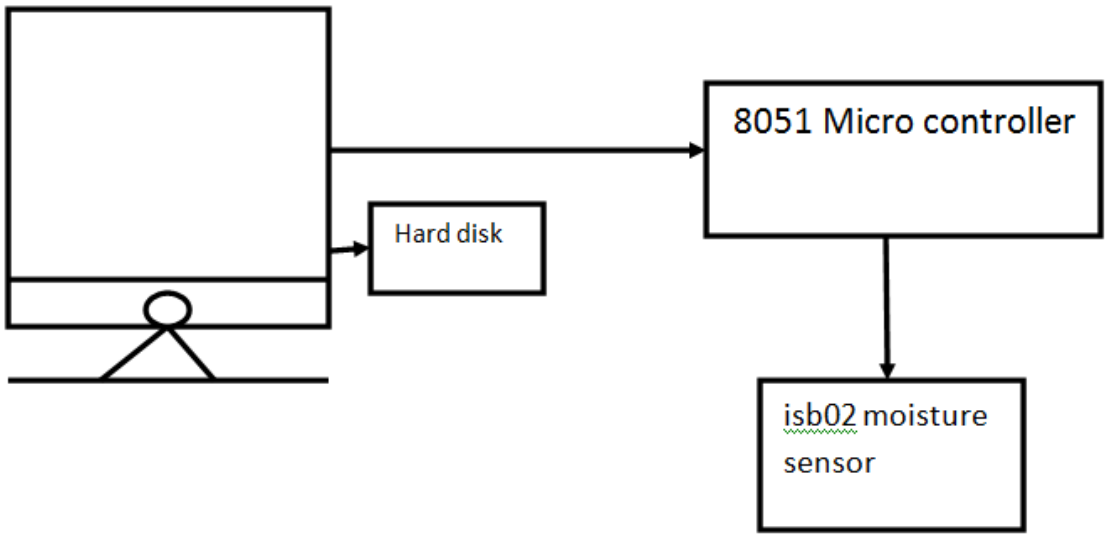

Figure 2.4: Alternative design 3

The above figure represents alternative design 3 in which water usage data of particular area is collected and water is distributed based on that data.

2.4 Final design

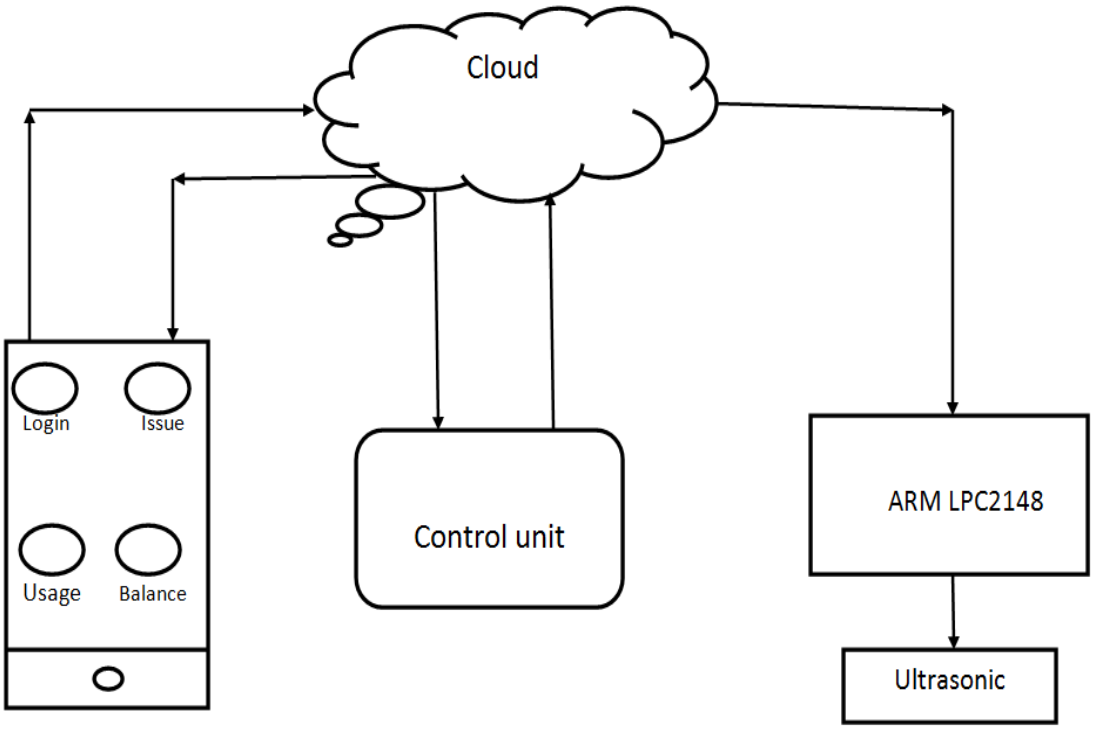

Figure 2.5: Final design

The above figure represents the final design. In this design water is distributed based on the user's requirement. Water leakages are detected using ultrasonic sensor. Thus a effective demand driven water distribution system is achieved through this design.

Chapter 3

Implementation details

In this section algorithm, flowchart and other implementation details are explained.

3.1 Specifications and final system architecture (White Box)

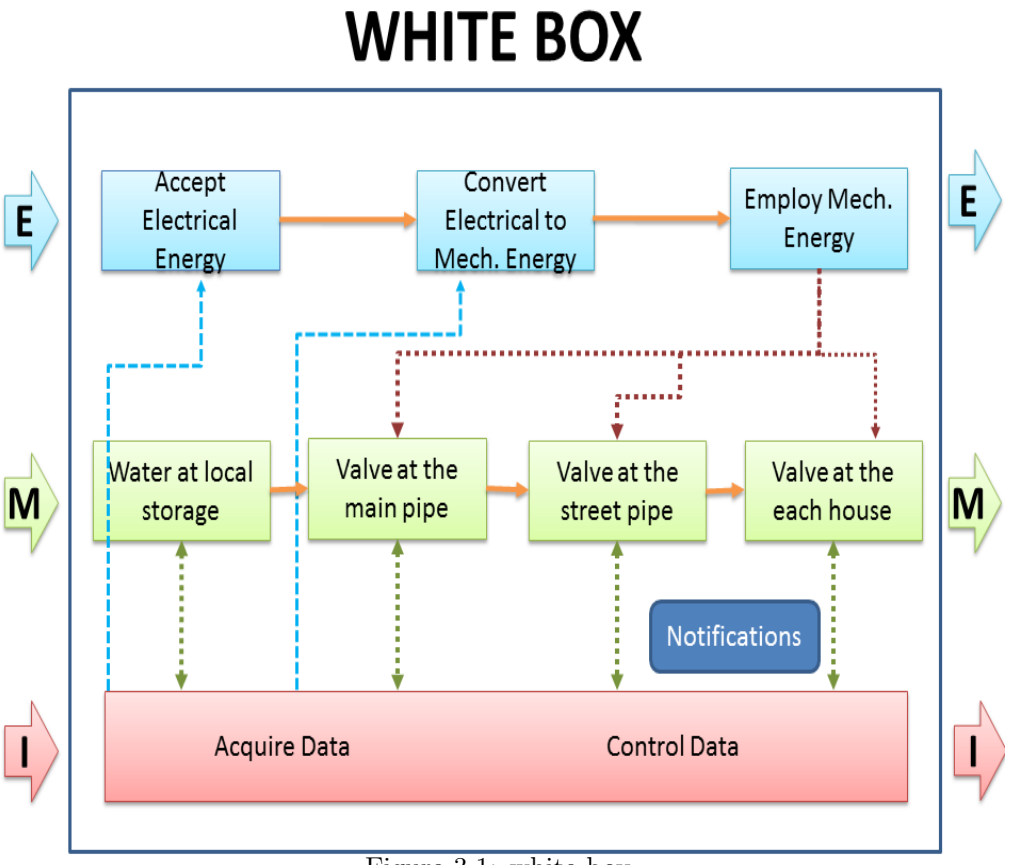

Figure 3.1: white box

3.2 Algorithm

STEP 1: Start.

STEP 2: Read user data.

STEP 3: Check balance.

STEP 4: Check water in reservoir.

STEP 5: Check leakage.

STEP 6: Turn ON valve for particular amount of time.

STEP 7: Stop.

3.3 Flowchart

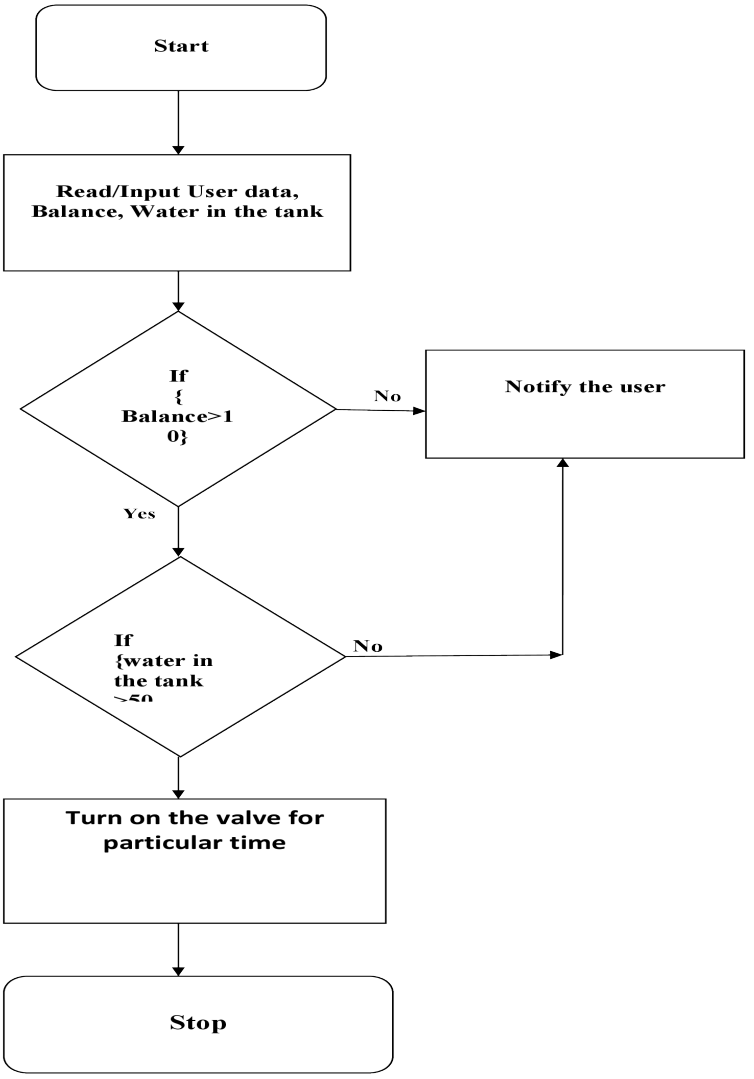

Figure 3.2: Flow chart

Chapter 4

Optimization

In this section optimization techniques and selection of optimization techniques is explained.

4.1 Introduction to optimization

Code optimization is the process of reducing the number of instructions without affecting the outcome of the source program. Code optimization modifies the code to make some of its aspect to work more efficiently, use fewer resources and be more robust. Avoiding bad quality coding can also improve performance, by avoiding obvious slowdowns.However, some optimization's are possible which actually decrease maintainability.

4.2 Types of optimization

- Machine Independent code optimization:
  The machine independent optimization can be achieved using the following criteria The code should be analyzed completely and use alternative equivalent sequence of source code that will produce a minimum amount of target code, Use appropriate program structure in order to improve the efficiency of target code, From the source program eliminate the unreachable code and move two or more identical computations at one place and make use of the result instead of each time computing the expressions.

- Machine Dependent code optimization:
  The machine dependent optimization can be achieved using following criteria Allocation of sufficient number of resources to improve the execution efficiency of the program, Using immediate instructions wherever necessary, the use of intermix instructions and the intermixing of instruction along with the data increases the speed of execution

4.3 Selection and justification of optimization method

Technique used for optimization are constant folding, loop optimization, global variable declaration, modularity and loop overhead. Constant folding as the name suggests, this technique involves folding the constants by evaluating the expressions that involves the operands having constant values at the compile time. Loop optimization Consumes 90 percent of the execution time a larger payo to optimize the code within a loop.

Chapter 5

Results and discussions

Following results are obtained by successful implementation of the final design.

5.1 Result Analysis

The user data is collected from android application and successfully stored in cloud. In control unit the generated excel sheet from the server is accessed and water flow is monitored.The leakages are detected by monitoring the water flow. Then, the commands are sent to controller for turning on/off the valves for particular amount of time.

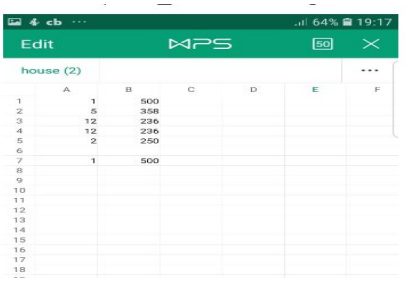

Figure 5.1: excel sheet data

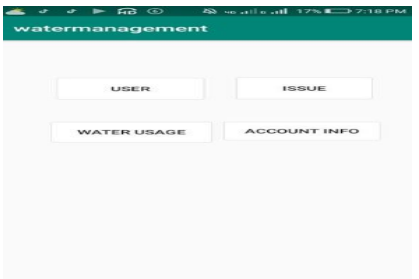

Figure 5.2: Android application

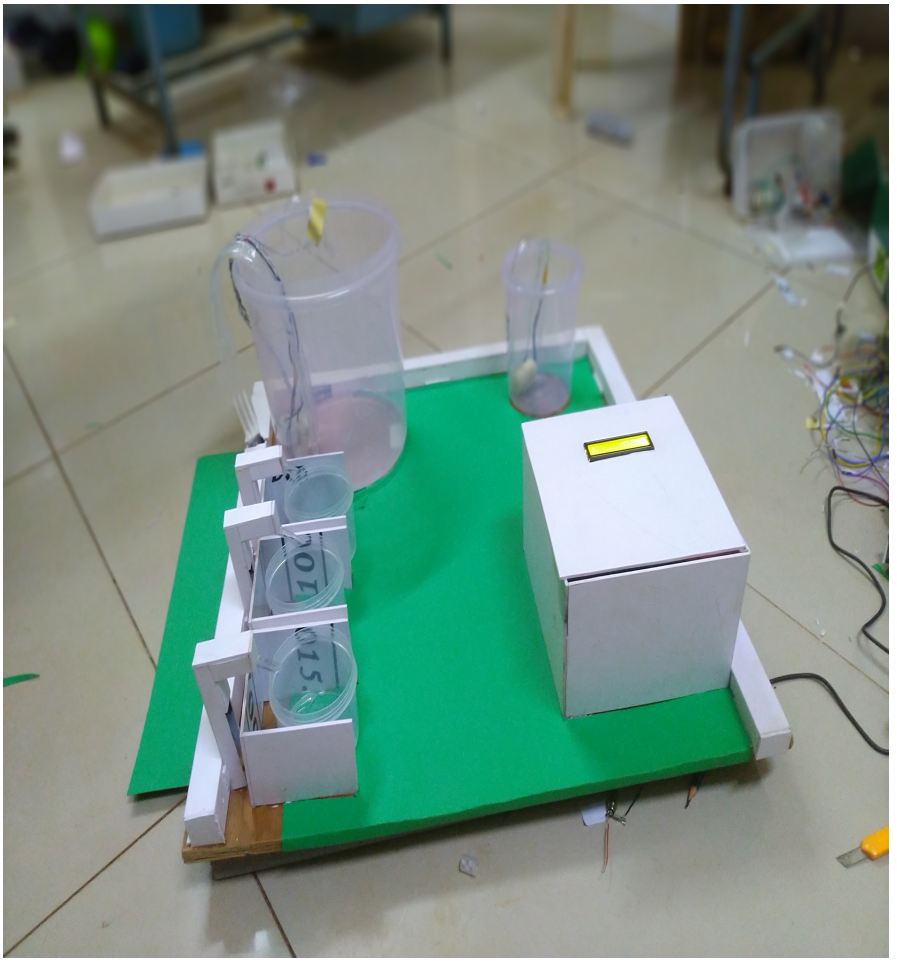

Figure 5.3: Final product

5.2 Discussion on optimization

Before optimization the code the time taken was more and memory consumed was 5764 Bytes. After using optimization techniques time taken is less and memory consumed is 5456 Bytes. The principal advantage is that after optimization code typically uses less CPU cycles, which means it runs faster and uses less power. This plays very important role in enhancing the system performance. Optimization of the code is often performed at the end of the development stage since it reduces readability and adds code that is to increase the system performance.

Chapter 6

Conclusions and future scope

The conclusion and future scope of product is explained in this section.

6.1 Conclusion

This internet of things(IOT) based design overcomes drawbacks of current water management system. This design provides an efficient system for monitoring the water supply. This system can be easily installed in residential societies. Optimized water distribution, Huge data collection of water usage, Demand prediction, Online water billing, reduce unaccounted water loss, creating common platform for user and distributor to improvising the system eectiveness is achieved in this closed loop automated water distribution system.

6.2 Future scope

Android application is provided to all the residents of particular area. Huge data collected by this way is analyzed using machine learning algorithms. Water bills will be made online. Demand prediction by analyzing huge data for providing adequate water supply. This system is implemented at the dierent zone of the city so problem in portable water system or pocket of abnormality can be found at micro level. Water quality control can be added as feature for this system.

6.2.1 Application in the societal context

This system is best suited for the apartments. This system can be implemented in metropolitan cities for supervised water management.

Chapter 7

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