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Original Research Paper

Smart Water Level Indicator

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Abstract: The Water Level Indicator is beneficial to the public, especially to residents living in rivers. This technology can provide early warnings to residents when the water level is occupying a dangerous level and facilitates workers who control the dam of the river. This technology can alert early through sirens and notifications / messages via smartphones as well as to the river dashboard controllers capable of controlling water gates through their smartphones. The worker who controls the dam of this river no longer needs to go back to the dam's door control house to open the water dam door. Workers who are in charge of controlling dam need to stand in one place only to open their smartphones and control the dam's doorway using the fingertips. To the people living in the river, they do not have to worry about the floods that will happen in their area. They will get an early warning about the flood at any time even when they are sleeping. They will get the warning via notification on their smartphone and siren is places in a certain area to produce a loud noise so that residents can be prepared to face the disaster. It is expect that the Water Level Indicator is able to take a step further and can be use as best as possible and can help the local community.

Keyword: Water Level, Internet of Things, Flood.

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1. Introduction

The Water Level Indicator is beneficial to the public, especially to residents living in rivers. This technology can provide early warnings to residents when the water level is occupying a dangerous level and facilitates workers who control the dam of the river. This technology can alert early through sirens and notifications / messages via smartphones as well as to the river dashboard controllers capable of controlling water gates through their smartphones.

The worker who controls the dam of this river no longer needs to go back to the dam's door control house to open the water dam door. Workers who are in charge of controlling dam need to stand in one place only to open their smartphones and control the dam's doorway using the fingertips. To the people living in the river, they do not have to worry about the floods that will happen in their area. They will get an early warning about the flood at any time even when they are sleeping. They will get the warning via notification on their smartphone and siren is places in a certain area to produce a loud noise so that residents can be prepared to face the disaster. It is expect that the Water Level Indicator is able to take a step further and can be use as best as possible and can help the local community.

2. Literature review

2.1. Internet of Things

Internet of Thing (IoT) is a concept where an object has the ability to transfer data through a network without requiring human-to-human or human-computer interaction. IoT has evolved from the convergence of wireless technology, micro-electromechanical systems (MEMS), and the Internet [1, 2, 3, 4, 5].

"A Things" on the Internet of Things can be defined as a subject, for example a person with a heart implant monitor, a farm animal with a biochip transponder, a car that has a built-in sensor to warn the driver when tire pressure is low. So far, IoT is most closely related to machine-to-machine (M2M) communications in manufacturing and electricity, oil and gas [4, 6, 7]. Products are built with M2M communication capabilities which are often referred to as "smart" systems. For example, smart cables, smart meters, smart grid sensors.

In addition, it can also be said that IoT as a global network infrastructure, which connects physical and virtual objects through the exploitation of data capture and communication capabilities [8, 9, 10]. Infrastructure consists of existing networks and the internet and its network development. All of these will offer object identification, sensors and connection capabilities as a basis for the development of independent cooperative services and applications [2, 7, 9, 11, 12]. It is also characterized by a high degree of autonomous data capture, event transfer, network connectivity and interoperability [13].

2.2. Servo Motor Pinout Wires

Features of Servo Motor (SG90), namely [10]:

1. Operating Voltage is +5V typically
2. Torque: 2.5kg/cm
3. Operating speed is 0.1s/60°
4. Gear Type: Plastic
5. Rotation : 0°-180°
6. Weight of motor : 9gram
7. Package includes gear horns and screws

Figure 1. Servo Motor Pinout Wires

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Table 1. Wire Configuration

Wire Colour	Description
Brown	Ground Wire
Red	Power Wire typically +5V
Orange	PWM signal is given in through this wire to drive the motor

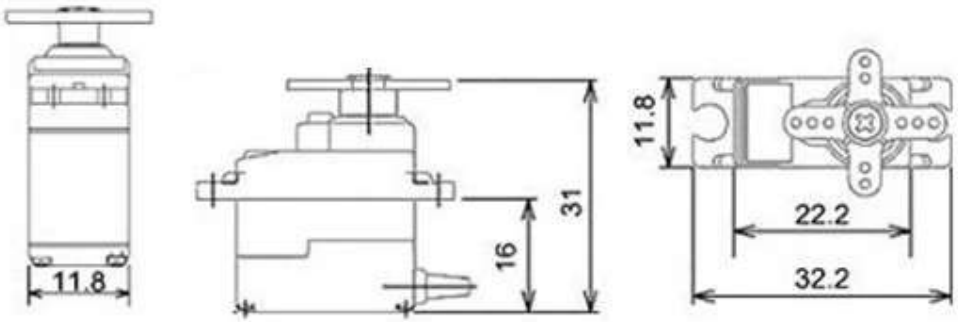

Figure 2. Servo Motor (SG90) Dimensions

2.3. ESP32 DevKitC (NodeMCU)

In terms of power and features obviously the dual cored microprocessor powered ESP32 will surely take down the microcontroller powered Arduino UNO. The ESP32 has built in Bluetooth and Wi-Fi with good number of GPIO pins and communication protocols [10].

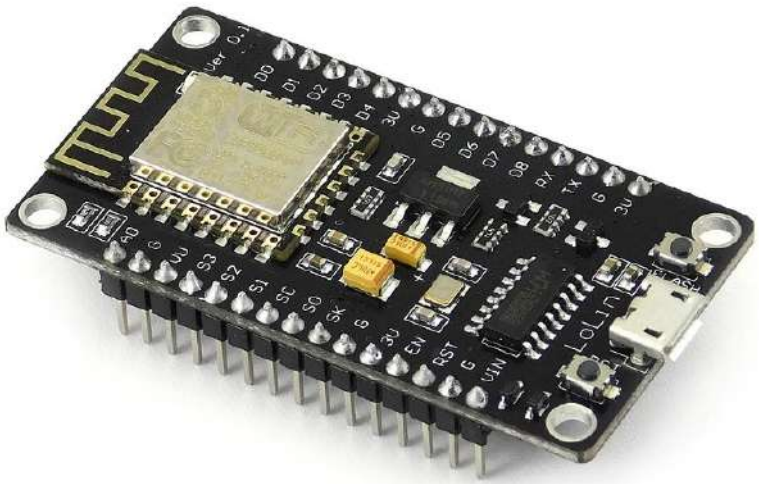

Figure 3. ESP32 DevKitC (NodeMCU)

The ESP32 is design for low power IoT applications in mind. It's high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating capabilities makes it ideal for most Portable IoT devices. Also now, since Arduino IDE has officially released board managers for ESP32 it has become very easy to program these devices.

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Table 2. Table Technical Specifications for ESP32 DevKitC (NodeMCU)

Microprocessor	Tensilica Xtensa LX6
Maximum Operating Frequency	240MHz
Operating Voltage	3.3V
Analog Input Pins	12-bit, 18 Channel
DAC Pins	8-bit, 2 Channel
Digital Input/Output Pins	39 (of which 34 is normal GPIO pin)
DC Current on Input/Output Pins	40 mA
DC Current on 3.3V Pin	50 mA
SRAM	520 KB
Communication	SPI(4), I2C(2), I2S(2), CAN, UART(3)
Wi-Fi	802.11 b/g/n
Bluetooth	V4.2 – Supports BLE and Classic Bluetooth

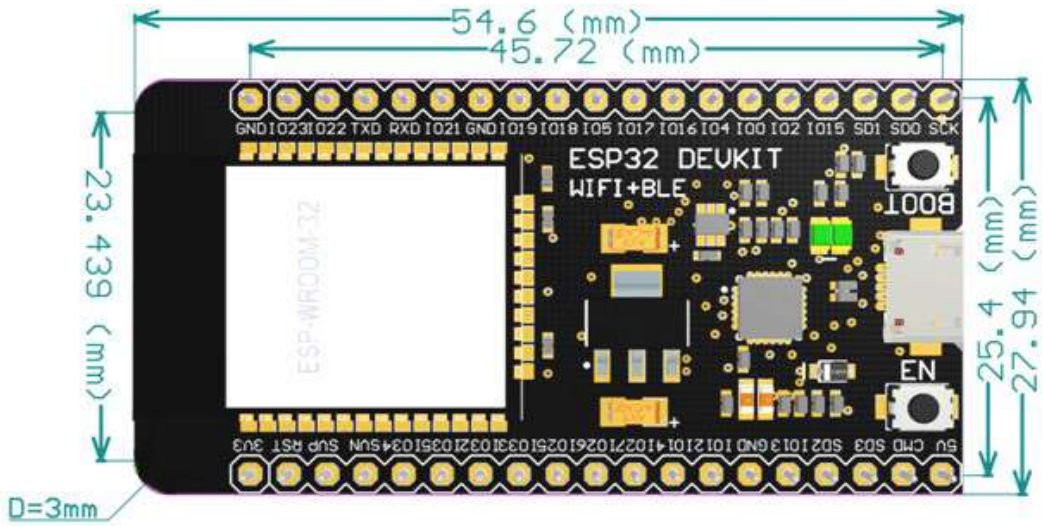

Figure 4. ESP32 2D Model

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There are three ways by which to power an ESP32 board, namely:

1. Micro USB Jack
   Connect the mini USB jack to a phone charger or computer through a cable and it will draw power required for the board to function
2. 5V Pin
   The 5V pin can be supplied with a Regulated 5V, this voltage will again be regulated to 3.3V through the on-board voltage regulator. Remember ESP32 operated with 3.3V only.
3. 3.3V Pin
   With a regulated 3.3V supply then it is directly provide to the 3.3V pin of the ESP32.

2.4. Arduino Uno

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller [11]. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

The 14 digital input/output pins can be used as input or output pins by using *pinMode()*, *digitalRead()* and *digitalWrite()* functions in arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default.

Out of these 14 pins, some pins have specific functions as listed:

1. Serial Pins 0 (Rx) and 1 (Tx): Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
2. External Interrupt Pins 2 and 3: These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
3. PWM Pins 3, 5, 6, 9 and 11: These pins provide an 8-bit PWM output by using analogWrite() function.
4. SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK): These pins are used for SPI communication.
5. In-built LED Pin 13: This pin is connected with a built-in LED, when pin 13 is HIGH – LED is on and when 13 pin is LOW, it is off.

Figure 5. Arduino Uno

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Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog Reference () function.
Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.

Arduino Uno has a couple of other pins as explaination.
AREF : Used to provide reference voltage for analog inputs with analogReference () function.
Reset Pin : Making this pin LOW, resets the microcontroller.

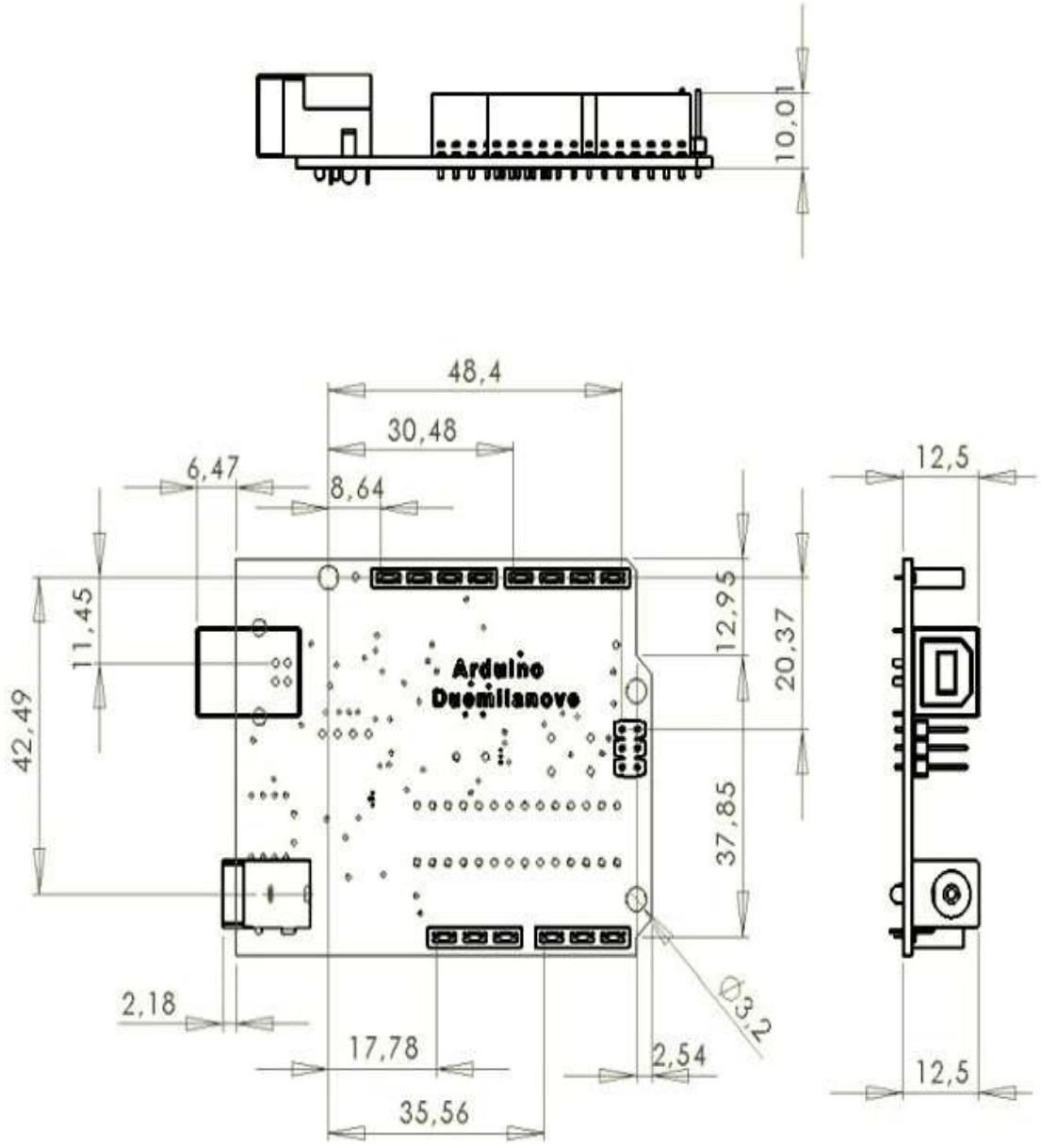

Figure 6. Arduino Uno 2D Model

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Table 3. Arduino Uno Technical Specifications

Microcontroller	8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7- 12 V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital Input/Output Pins	14 (Out of which 6 provide PWM output)
DC Current on Input/Output Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

2.5. Resistor

Resistors have two leads, there is no polarity for a resistor and hence can be connected in both directions.

Figure 7. Resistor 301k

The value of resistor gets inversely added up when they are parallel and the value of resistors get added up when they are place in series.

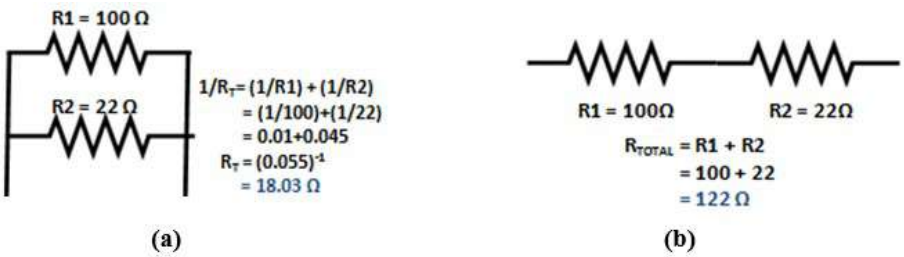

Figure 8. Resistor Value
(a) Resistor in Parallel
(b) Resistor in Series

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In order to identify the resistance value of a Resistor, we have to look at its colour code. It would have been easy if the value was directly written, but still with little practise from below we can start reading the resistor values.

Resistors are not available in all values. Therefore, if you project needs a particular value which is not commonly available then you have to make up the value by using either series or parallel combination in Figure 9.

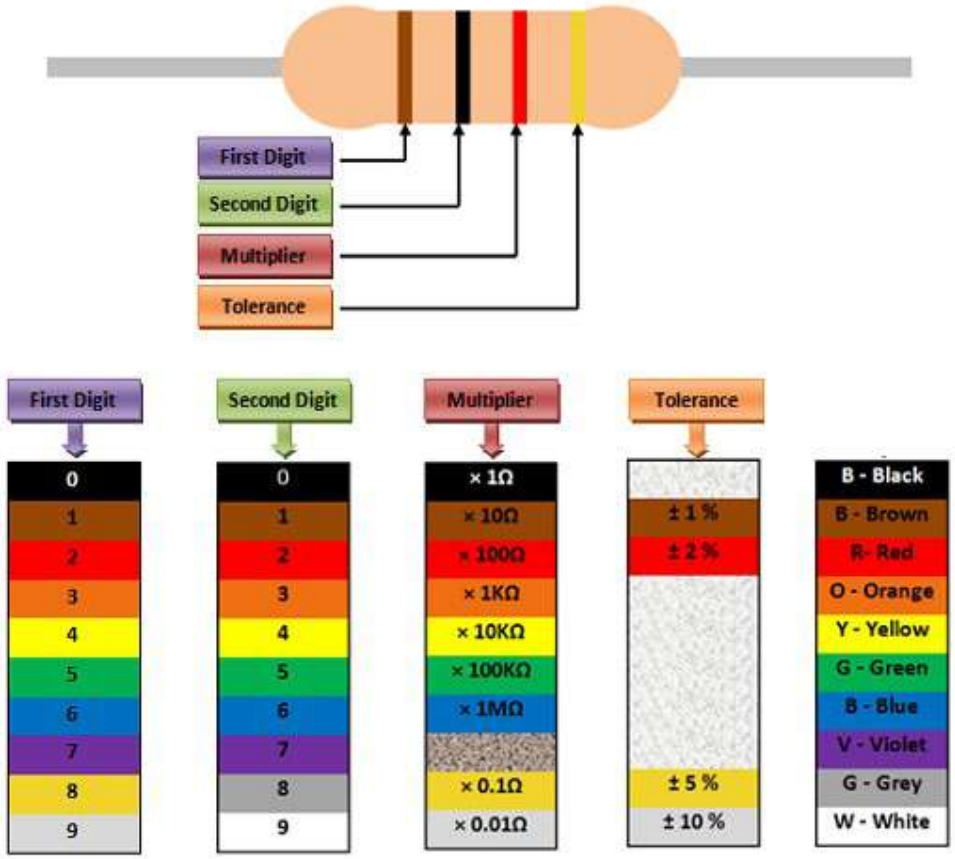

Figure 9. Parallel Combination

2.6. BC547 Transistor

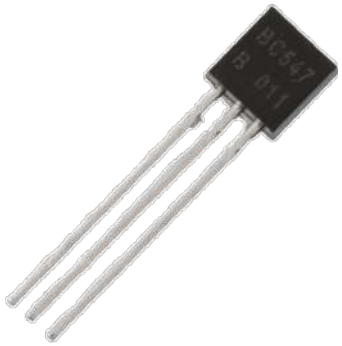

Figure 10. BC547 Transistor

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Table 4. Pin Configuration

Pin Number	Pin Name	Description
1	Collector	Current flows in through collector
2	Base	Controls the biasing of transistor
3	Emitter	Current Drains out through emitter

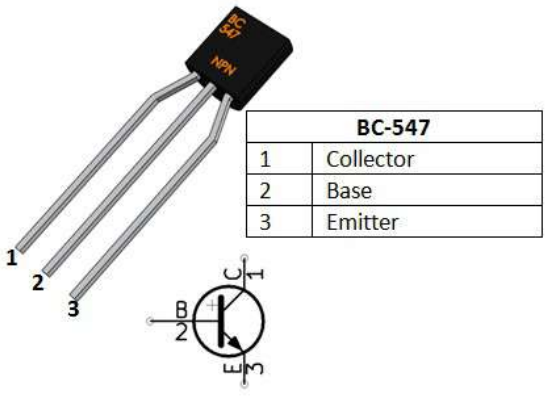

Figure 11. BC547 Transistor Pinout

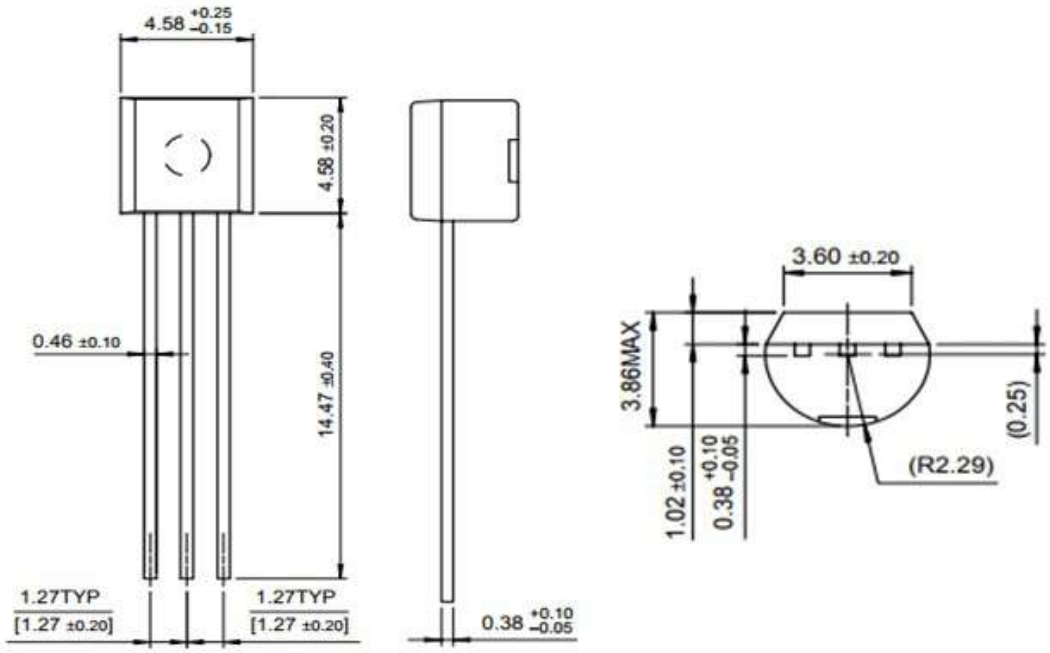

Figure 12. 2D Model of the Component: BC547 Transistor

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3. Method

Smart Water Level Indicator is design using the Agile Development Methodology (Continuous Deployment) method. Through this method, information gathering has been conduct by creating a question form (google docs) on issues in the river area. In addition, the flow chart diagram is design to facilitate the implementation of the Smart Water Level Indicator, to be more organize and run smoothly.

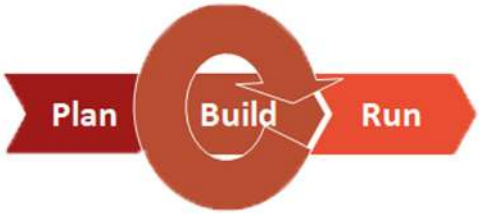

Figure 13. Agile Development Methodology

Through the implementation process, the coding of the Smart water Level Indicator technology has been builed using the existing coding on the Internet and modified according to the suitability of the project. These coding has been changed using Arduino.cc software. Through the test process, a questionnaire was distribute to several samples consisting of UPSI students to test the success of the Smart Level Indicator project to obtain a study on this system.

Finally, the process of development. Through this process, the Smart Level Indicator can be improve and modified after the results of the study of several samples are obtain.

The rationale for producing this technology is with the designed flowchart, as shown in Figure 14.

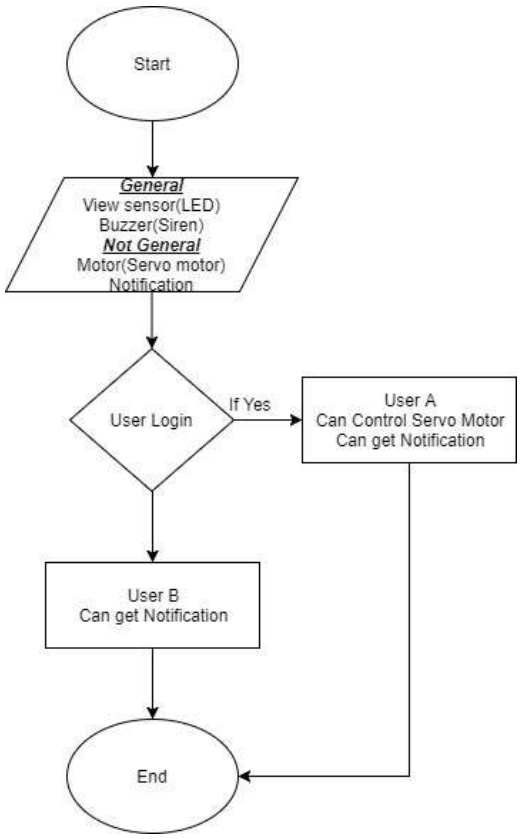

Figure 14. Flowchart for Smart Water Level Indicator

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4. Testing

The Smart Water Level Indicator can be work well as requested. We can get the warning by hearing sirens and being notified on the smartphone.

Based on the functionality analysis, it was find that 90% of consumers said the Smart Water Level Indicator very user friendly and can be used in the future. While 10% disagree with a reason,

5. Conclusion

The Smart Water Level Indicator can benefit the dam gate operators, they can see the river's water level and get an initial warning when the river water is at high level. With that, they do not worry about the river's water level anymore. They can get an earlier warning before the river water flooded out of the river and flooded the area.

The strength of the Smart Water Level Indicator can have a great impact on the community. This technology is capable use just by using smartphones. For example, the dam gate operators can control the dam's door gates by using only smartphones.

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