Wireless Underwater Data Transfer

By

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Certificate

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of BS (EE).

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Internal Examiner	External Examiner

Dedication

This project is dedicated to our parents, who support us in every step of life through thick and thin, who have raised us the person we are today. Also, this project is dedicated to our professor Dr. Majid Shehzad (late) who taught us the way of living life. Thank you all for unconditional love and support.

To top it all, we are thankful to our supervisor Hasan Danish, without whom none of this work has been possible.

Acknowledgements

First of all, we are thankful to Allah Almighty with whose support and blessing we are able to accomplishment this project.

The completion of this project would not have been possible without the help of our supervisor M. Hasan Danish Khan who converted our formidable idea into reality. He gave us best the advices and best guide through the project.

We also acknowledged the support of our family, friends and teachers.

Abstract:

The comprehensively unexplored area of the sea, covering around 66% of the surface of Earth, has entranced people since the first human being on the planet. This project review about the efficient data transfer through wireless data communication using physical wave as transporter among the hubs in the underwater sensor arrangement.

Wireless Sensor Network (WSNs) lies on small hubs with sensing, calculation, and wireless data communications potential. These sensors can impart either among each other or specifically to an external control-room (CR). Sonar sensor are associated with in excess of one hub in the system with a point-to-point interface – this takes it conceivable to exploit a portion of the repetition that is given by a physical completely associated work shape without the cost and intricacy required for an association between each hub in the system.

Deployment of a sensor network in the applications can be very useful for others like in our project we are building a safe environment for scuba divers. In many daily life examples, sensor hubs are switch on by batteries and constrained in energy supply. Thus, the newly discover techniques that omit energy inefficiencies that would decrease the lifetime of the network.

In our project we are using radio frequency (RFID) for underwater wireless communication which is Self-configured. We are using radio frequency (RFID) on this level ~~because~~ it is low component cost , low maintenance cost so we can use it as a prototype in our project in bigger scale we can use bidirectional Wi-Fi module for underwater wireless communication in sea.

According to the network structure, the routing protocols of communication are classified as hierarchical, location based or flat. All data hubs are assigned equal roles or working. We are also using sonar sensor in case of emergence like if any other diver jumps in water other then scuba diver so sonar will detect the diver and in any case of emergence its send signal to control so that we can avoid any accident.

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Chapter # 1

Introduction

1.1 Background:

The developing interest for inescapable underwater observing and control frameworks has fortified research on arrange conventions for underwater acoustic sensor systems. A few arrangements have been proposed over the most recent couple time at the distinctive portion of the code pack. However, having a total and exact comprehension of the execution of these protocols isn't a simple undertaking. Building the protected condition for scuba divers and swimming pool has been turned out to be an intense issue. This can be accomplished by the usage of sonar sensors organize and persistently observing from the control room. Our proposed plan for this issue is financially savvy as a contrast with others.
This proposed solution investigates applications and difficulties for underwater sensor systems. We feature the uses of checking and building a sheltered situation for scuba and different divers. The greatly unexplored territory of the sea, covering around 66% of the planet Earth, has interested people for whatever length of time that we have records. This task survey about the productive and cost impact of information exchange by means of remote correspondence through the physical wave as transporter among the hubs in the underwater sensor arranges. The physical wave would be a flag from jumper for development alarm. We are utilizing ultrasonic wave for transmitting and accepting sign at 40 kHz.

1.2 Problem Statement:

Wireless Sensor Network (WSNs) comprise of little hubs for detecting, calculation, and remote correspondences capacities utilizing ultrasonic wave. These sensors can impart either among each other or specifically to an outside control-room (CR) where all the movement and crisis are observing. Sonar sensor is associated with in excess of one other hub in the system with a point-to-point interface – this creates it conceivable to exploit a portion of repetition that is given by a physical completely associated work shape without the cost and multifaceted nature need for an association for each hub in the system. Each jumper has particular tone (DTMF) double tone multi frequency.

The arrangement of a sensor organize in the applications can be exceptionally valuable for others like in our task we are building a safe environment for scuba jumpers. In numerous applications, sensor hubs are controlled by batteries and obliged in vitality supply. Inventive systems that dispense with vitality wasteful aspects the lifetime of the system are exceedingly need. Gadgets, for example, sensors, receiving wires and preparing parts couldn't be removed in the field. This likewise kept the substitution of harmed reception apparatuses and sensors in-situ amid organization.

1.3 Project Objective:

In our project, we are utilizing radio frequency (RFID) for underwater wireless communication which is Self-arranged and there is another reason of planning radio frequency(RFID) in light of the fact that submerged radio frequency (RFID) is not accessible. We are utilizing radio frequency (RFID) on this level since it is low segment cost, low maintenance cost. There is an IC (MT8890) is utilized as a part of the module of radio frequency(RFID) to recognize the particular frequency of particular tone for the particular diver. As per the identified frequency chose calculation in microcontroller can distinguish the diver. We are utilizing microcontroller (8059) in light of the fact that it can without much of a stretch arranged in underwater as of PIC. We are utilizing radio frequency (RFID) as a model in our task in greater scale for information correspondence on most extreme separation we can utilize bidirectional Wi-Fi module for underwater wireless communication in the ocean. We are planning this module on printed circuit board (PCB) board with the goal that we can limit the measure of the module.

1.4 Project Scope:

All of the steering conventions can be grouped by the system structure as level, various leveled, or area based. In directing conventions, all hubs are doled out equivalent parts or usefulness with particular time and tone. We are utilizing sonar sensor if there should arise an occurrence of development like if some other diver jumps in water other then scuba diver so sonar will recognize the diver and regardless of rising its send flag to control with the goal that we can maintain a strategic distance from any mishap.

Chapter # 2

Literature Review

The use of the 2.4 GHz ISM frequency bandwidth for underwater wireless data communication [1]. In this idea, engineers show their wireless network sensors sequence and take the real time tests. Assessments for specific frequencies, data transfer rates and amplifications. The final tests show the maximum gap between network of sensors, the quantity of misplaced packets and the common round experience time. According to their assessments, they provide some assessment ideas of underwater wireless communication in pure water using EM waves of 2.4 GHz ISM[1] frequency bandwidth. Finally, they contrast their correspondence framework proposition and the current frameworks. Despite the fact that their proposition gives short correspondence separations, it gives high information data rates. EM wave with High-Frequency signal does not infiltrate and spread somewhere down in submerged situations. The characteristics of EM wave in water tend to oppose their engendering and produce extreme lessening. Transmission speed of EM decreases as water quality decrease [2]. In our project, a simple underwater communication model for is proposed to evaluate ultrasonic waves as a medium for wireless communication.

Diverse submerged sensor organize foundation has been proposed in the distinctive stage in the past to assess new convention answers for submerged sensor systems [3] and [4]. This foundation permits partner the utilization of acoustic modems with a product-based convention stack. In [4], the improvement of MAC convention is actualizing utilizing C code is utilized as a part of the test system and the modem too, constraining any code revising. The limitation of these sorts of arrangements is that with an end goal to utilize them to test new conventions designers need to take a gander at exclusive models and programming. This is ordinarily now not insignificant and it way that convention code normally should be reworked to check it in particular settings, which thusly restrains openness to testing focuses. We are utilizing sonar sensor systems and radio recurrence recognizable proof arrangement, sonar distinguishes the particular ID and transmits an incentive for the identified ID, from where utilizing microcontroller calculation, the distinguished ID recognized.

[5] This paper describe 3 center point accelerometer data trade more than meter submerged route at ten cm significance using a 2400 bit per second optical remote repeat move keying (FSK) at low repeat (VLF) . The adjust frequencies used were 10 and 12 KHz. The model modem was laid out and completed for continuous feedback for swimmers in the pool. The optical transmitter joined an accelerometer unit along with a microcontroller, the modulator and an identifier circuit in light of a planned locator preamplifier. Range tests were performed

[1] Industrial, Scientific and Industrial radio band

in air and submerged, with and without bubbles. The submerged range decreased to 70 cm with bubbles. The openness of the association between the wrist and pioneer of a swimmer was around half and changed with the situation of the wrist. This enables stroke rate data to be displayed to the swimmer by methods for a goggle mounted show.

However, there are some limitations for optical underwater communication. Optical signals are immediately dissolved in water. Thirdly, high level of atmosphere light in the upper part of the water cabin is another contrary effect for using optical communication.

[6] The shallow water acoustic correspondence the channel shows a long defer spread due to various multipath landings coming about because of surface and base associations. Development of transducers, sea surface, and inside waves prompt fast time variety and, thusly, a high Doppler spread in the channel. Reasonable adjustment plans, for example, stage move keying [2](PSK) alongside versatile choice criticism equalizers (DFE)[3] and spatial decent variety consolidating have been appeared to be a powerful method for correspondence in such channels. The long postpone spread (frequently hundreds of images) and fast time variety of the channel regularly makes this approach computationally excessively complex for ongoing executions.

In a bunch, the correct decision of physical layer convention may rely upon components such as particular channel conditions, security reasons, preparing capacity, the information rate prerequisites and vitality productivity. In the view of constrained data transmission submerged, the abnormal state of cross-layer improvements or rising above of customary layer limits might be expected to give high information rates. We now audit a portion of the current work furthermore, future difficulties. The key focal point of our audit will be on the information connect layer (DLL) [4]furthermore, organize topology.

[7] they are physical and designed frameworks that work in a way that their components are controlled, observed, facilitated and coordinated by a hidden center of registering and correspondence activities. According to [8], they infer a tight incorporation of physical, correspondence and calculation components going from gadgets to transportation and vitality frameworks. All things considered, in spite of the fact that CPSs can be depicted in a wide range of ways, they for the most part suggest an accumulation of gadgets disseminated in a specific area that connect with the earth by methods for programming-based charges that are

[2] Wi-Fi Protected Access Pre-shared key
[3] Decision Feedback Equalizer
[4] Dynamic link library is a collection of small programs which lets the larger program communicate with specific device.

sent and got with an insignificant association from a human end client. This is no special case with respect to the reconciliation of interchanges at the information level in regards to sea mechanical technology. This last sort of gadgets can be better depicted as the standard vehicles produced to perform over-and subsea tasks.

Security is a standout amongst the most critical parts of diving. In different diving frameworks, there is a wide range of strategies for wellbeing in light of the advanced science and existing dangers and issues for divers. In this technique, there is a special sensor, which is put on the lower arm of diver. This special sensor is use with plc and screen. Its value depends on the heartbeat of the diver. In our project, we are using the same approach but different methodology. We are using sonar sensor which detect the diver and also provide communication with control room. [9]

Chapter # 3

Requirement Specifications

3.1 Existing System:

The present solution of scuba diver safety contains a hand-held unit including a show screen. Messages and illustrations are composed on the show screen utilizing an electromagnetic pen. Markings on the screen can be immediately cleared, saved or transmitted to another, similar machine by setting the electromagnetic pen in closeness to a summon symbol on the screen.

Disadvantages of existing system:

1. Does not communicate with control room.
2. Waterproof screen and electromagnetic pen are cost expensive.
3. Not suitable for the emergency condition

3.2 Proposed system:

The proposed system is a sagacious way to deal with a progressing evaluation and selection of things in a steady stream. Existing arranging methodology uses a setup of sonar sensors and their communication with control room on the basis of the identification of RFID. Our proposed solution also covers swimming pool safety with sonar sensors arrangement at the bottom of the pool.

Sensors will be at the bottom of the sea with some specific distance. When any scuba diver passes through these sensors having RFID tag on their wristband, these sensors detect its RFID and transmit the specific signal tone to control room as well as to other scuba divers using ultrasonic wave as the carrier wave. Other scuba divers have the location of their partner scuba diver at their wristband.

Now in control room, the receiver receives this signal and after analog to digital conversion, it transmits this signal to the microcontroller 8059. Microcontroller processes this signal with respect to an algorithm that identifies and separates the different tones of the different diver. After the separation and identification of the specific diver, microcontroller transmit this message to the LED for the show the results.

If any sonar sensor does not detect the scuba diver RFID within the specific time, that sonar sensor will generate the error value and transmit it to control room and other scuba divers. In that case, if that scuba diver collecting some sample from the ground, it can transmit the “OKAY” signal from his wristband to control room and other scuba divers.

For instance, if an accident occurs and scuba diver does not cross the sonar sensor, it does not detect anything and transmit negative value to the control room and other scuba divers. If there is no “OKAY” signal from it then because of negative value generating sonar sensor location, other scuba divers will save him or ask for necessary help by communicating to control room.

3.3 Requirement Specifications:

These are as follows:

1. Sonar Sensors.
2. RFID
    - Encoder
    - Decoder
3. Microcontroller 8051.
4. LCD.

3.3.1 Underwater Ultrasonic Device:

Ultrasonic sensor is used to measure the distance by detecting the sound of the object. We are using this same technique to detect the location of scuba diver. By detecting the diver, it can tell us the location of the diver. It is very easy and cheap approach to detection

Figure 3.1 – Underwater Ultrasonic Sensor

Part number	ST-501 T/R	ST-502 T/R	ST-503 S	ST-504 S
Nominal Frequency [KHz]	40			
Sound Pressure[dB]	120min	112min	117min	110min
Directivity[deg]	55	72	55	72
Operating Temperature[℃]	-30°C ~ +80°C			
Max Input Voltage [Vp-p]	20Vms	20Vms	21Vms	22Vms
Detectable Range[m]	6max	4max	0.2~4	0.2~3
Dimension[mm]	Ø16x12h	Ø10x7h	Ø16x12h	Ø10x7h

Table 3.1 – sonar sensor parameters

(http://st4u.com/en/business-2/robot/ultrasonic-sensor)

3.3.2 RFID tag:

Radio Frequency ID named RFID is used at wristband of the scuba diver. There no underwater RFID tag available in a market so we used IC TP5089.

IC TP 5089 is a touch tone IC. Usually use at the keypad. It transmits specific tone against the specific number.

For decode the IC TP5089 tone, we use IC MT8870. It is use to decode the tone specific tone of IC TP5089, at control room and transmit signal to microcontroller.

3.3.3 Microcontroller 8051:

Microcontroller 8051 is very popular to use because of this simple C programming. It has 4 input and output ports which has further divided into 8 bits.

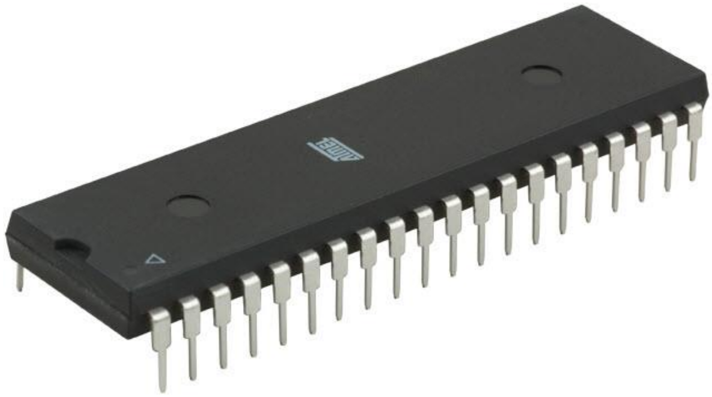

Figure 3.2 – Microcontroller 8051

(https://www.elprocus.com/8051-microcontroller)

Chapter # 4

System Design

4.1 System Design Flowchart:

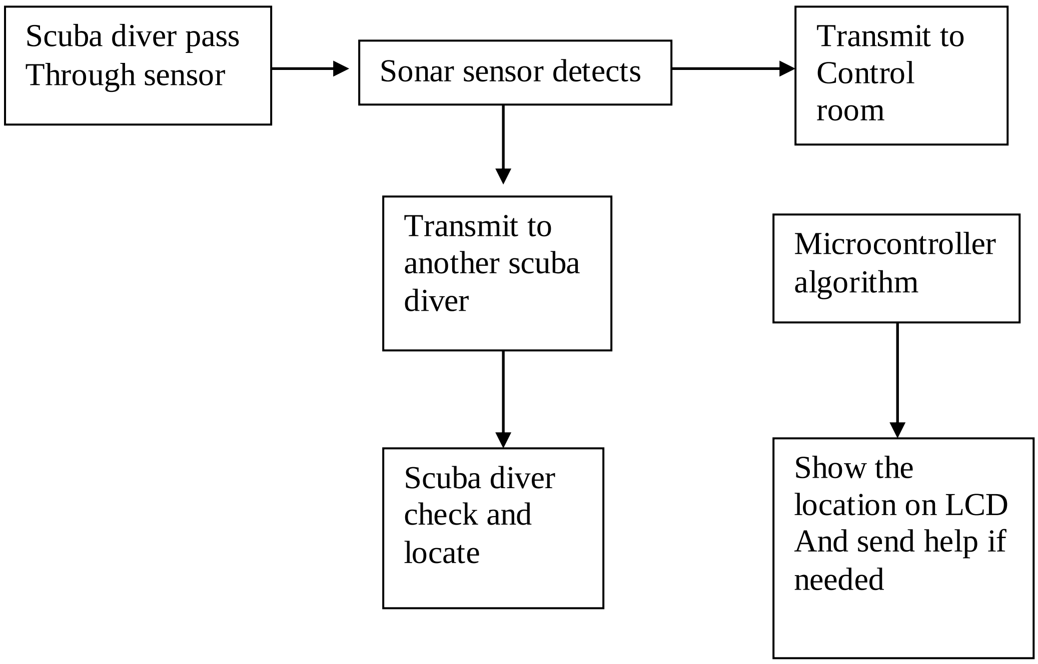

Figure – 3 system architecture

4.2 System Methodology:

The methodology is such that whenever a scuba diver jumps into the sea for the mission, it will have some specific tone which can be identify by using DTMF IC. The sonar sensor will sense the tone of the scuba diver. Then it will transmit the signal contain the location of this scuba diver to the control room and other scuba diver's wristband. This signal at the RFID tag will translate into analog domain and then amplify the signal. At the same time, sonar sensor signal is also amplified. These two modulated signals then transmitted to the control room where these signals again translated at the digital domain. Then using PT 2272 IC, decoder the transmitted signal and send it to microcontroller.

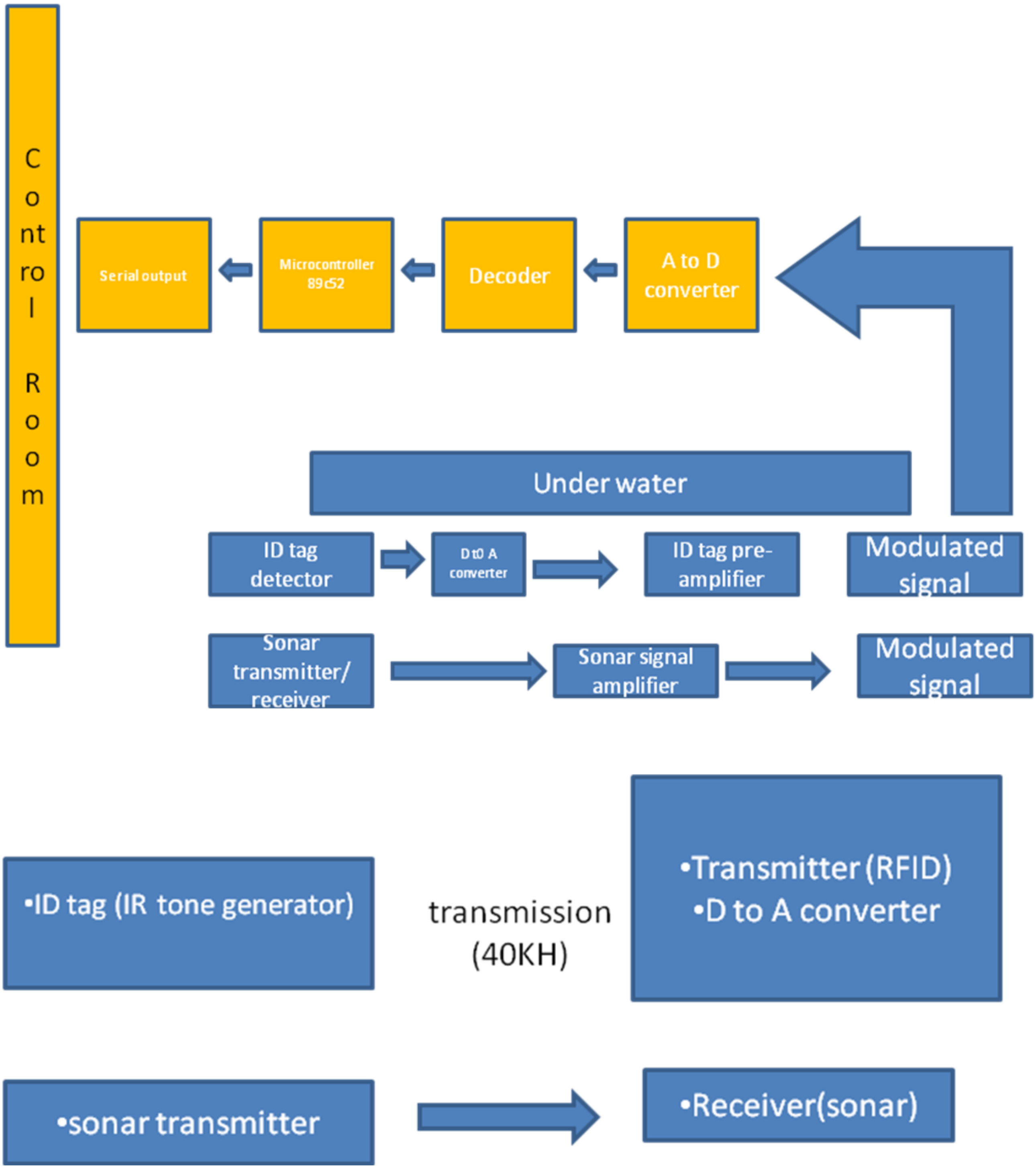

Figure-4 methodology

4.3 Wristband design:

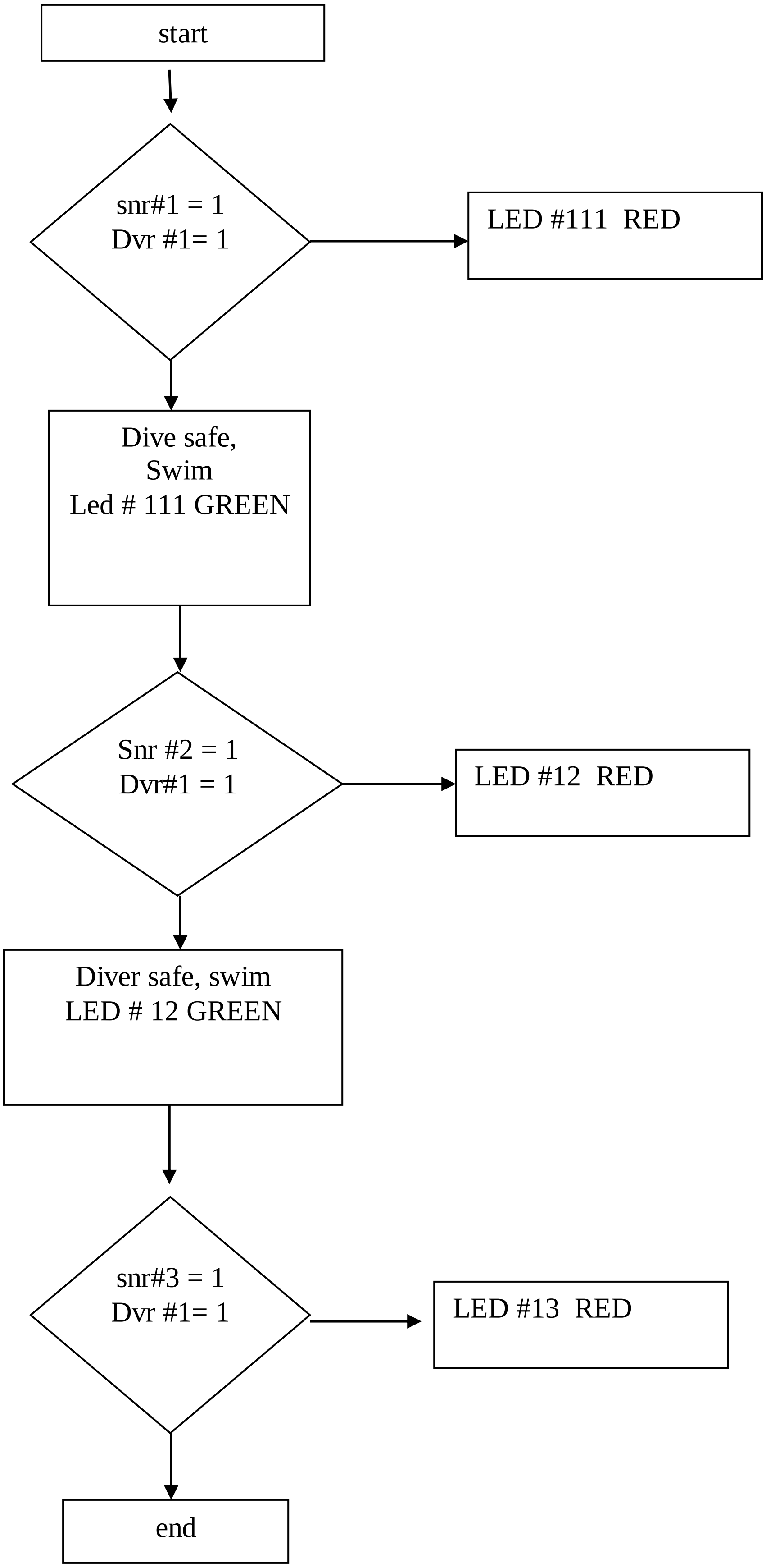

Figure 5- Flow chart

When the scuba diver passes the first sonar sensor, which are located at the bottom of the sea. Sonar will detect the diver and transmit the signal to the control room and other scuba divers. If sonar sensor does not detect the scuba diver at the specific time it will glow red light on the other scuba wristbands.

Chapter # 5

System Implementation

5.1 Ultrasonic transmitter:

This transmitter is used in wristband of scuba diver it will transmit the signal which is detected by the RFID tag.

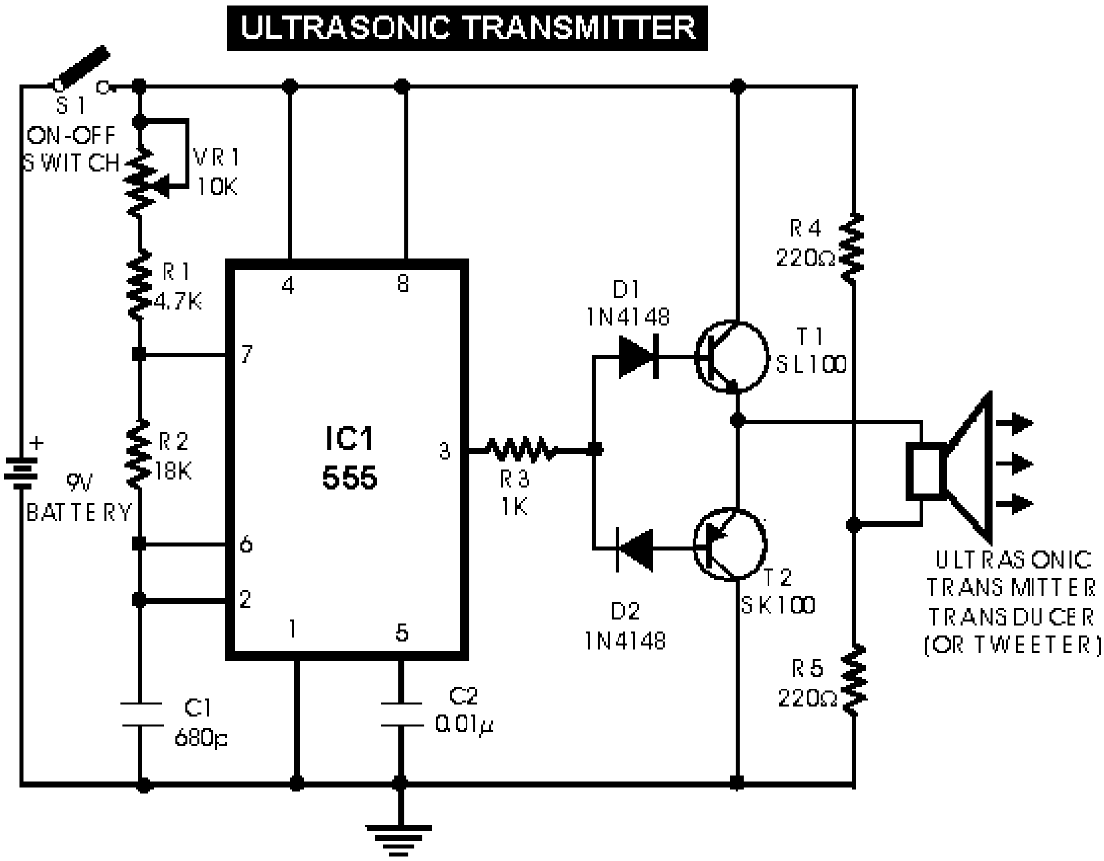

Figure 5.1 – Ultrasonic Transmitter

(https://goo.gl/images/yieieN)

5.1.1 Components used:

- IC NE 555
- Ultrasonic transmitter
- Diodes (1N4148)
- Transistors (SL100, SK100)
- Resistors and Capacitors

5.1.2 Working:

VR1 is used for matching the frequency of scuba divers on the wristband. Capacitors are used for frequency time scaling. Diodes are used as a switching diodes generator. 555 IC is used for frequency reference and amplitude of supplied voltage (5V). Pulse is generating from the 555 IC, it will split into positive and negative waves. D1 (as shown in figure 5.1) pass positive cycle of the wave through NPN (SL100) and the D2 (as shown in figure 5.1) pass negative cycle of the wave through PNP (SK100). We used diodes and transistors configuration because the signal which is emitted from 555 IC is not enough strong to operate Ultrasonic transmitter. And to ON the transducer, it needs the positive and negative pulse to generate it. The transistor is also used as an amplifier that will convert microampere current into milliampere current.

5.2 Ultrasonic Receiver:

This circuit is used in underwater at the base to detect the diver by his specific tone generating by the sonar transmitter at wristband.

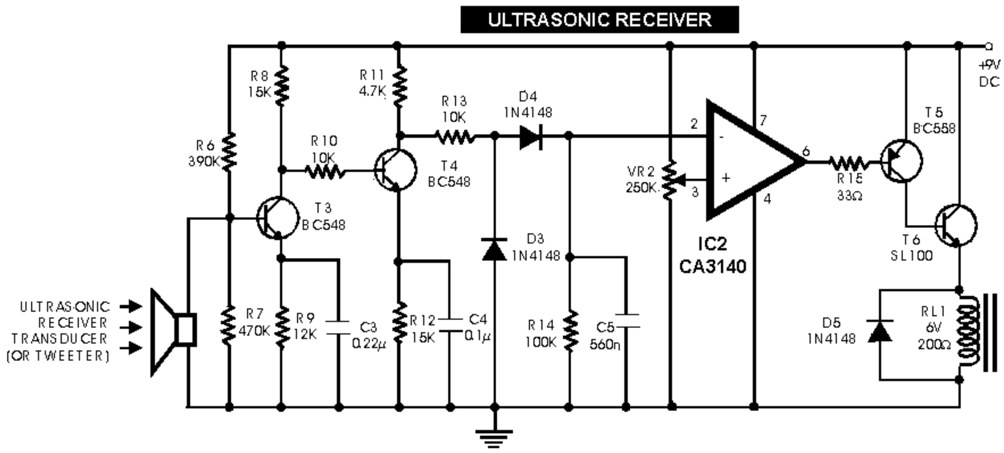

Figure 5.2 – Ultrasonic Receiver

(https://goo.gl/images/yieieN)

5.2.1 Components Used:

- Ultrasonic receiver
- Operational Amplifier (LM741)
- Diodes
- Transistors

- Resistors and capacitors

5.2.2 Working:

Resistor R6 and R7 (as shown in figure 5.2) are used for biasing and connect with positive voltage terminal of the battery. Resistor R8 and R9 provide the positive and negative voltage (as shown in figure 5.2) to the transistor T3. Capacitor C3 and C4 are used as the AC ground. Since it provides the low impedance path to the signal, the high-frequency signal with pass through it and the low-frequency signal will not be affected by it. Transistor T3 and T4 are working as multistage cascading. It will amplify the signal with high input resistance, low output resistance and provide large gain. After amplification from the transistors T3 and T4 (as shown in figure 5.2), the signal will pass through diode D4 and rectifiers it in DC. D3 is used as voltage doublers. C6 and R12 connected in parallel to form Zobel network. It will remove the noise from the signal and enhance it to improve DC factor. If we remove the Zobel network our circuit will not be tuned. Operation amplifier used as the series voltage regulator. To set the gain and calibrate it we connect the variable resistor to its non-inverting input. Instead of relay we use LED for the showing the output because relay consume more voltage for energized.

5.3 RFID (Radio Frequency ID) Tag:

This circuit includes the IC PT2262 in the scuba wristband. Its encode the signal and transmit to the base station.

5.3.1 Description:

PT2262 is a encoder matched with PT2272It encodes data and address pins into a serial coded waveform proper for RF or IR change. PT2262 has a most extraordinary of tri-state with 12-bits convey pins deliver up to 531,441 (or 312) address codes; along these lines, definitely decreasing any code impact and unapproved code examining potential outcomes.

5.4 Base Station Receiver:

This circuit includes the IC PT2262. It will receive the encoded signal from the PT2272 and transmit to microcontroller 8059 to identify the scuba.

5.4.1 Description:

PT2272 is a decoder matched with PT2262. It has tri-state of 12-bits address pins giving a most extreme of 531,441 (or 312) address, along these lines, radically diminishing any code impact and unapproved code checking conceivable outcomes. PT2272 is accessible in a few alternatives to suit each application requires: variable number of information yield pins, hook or passing yield write.

5.4 Base Station circuit:

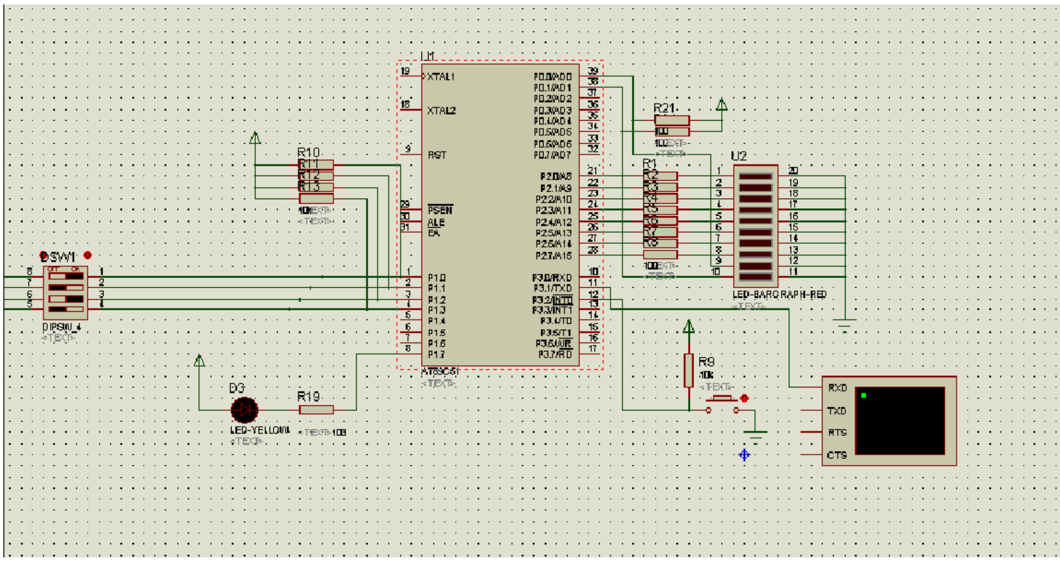

Figure 5.4 – base station circuit

5.4.1 Components used:

- Optocoupler
- Super capacitors
- LM714
- IC MT8870
- LEDs
- Microcontroller

5.4.1.1 Working:

Signal which is receiving from the IC PT2262,is first isolated using optocoupler. It prevents high voltages from affecting the system receiving the other signal or noise. Then signal is transmitted to the operational amplifier for amplifies the signal and then transmitted to the IC MT8870 for the identification of the signals. MT 8870 (dual tone multi frequency IC) detects the signal of different frequency which is been used for the transmission of the specific diver. This specific frequency signal will transmit to the microcontroller to decode the signal and identify the diver. Super capacitors are used for the noise removal at the very large scale because the signal which is transmitting to the MT8870 must be noise free. From microcontroller, signal will transmitted to the control room wirelessly.

5.4.2 Control room circuit.

In this circuit we use LCD interfacing with microcontroller to show the final name or identification on LCD.

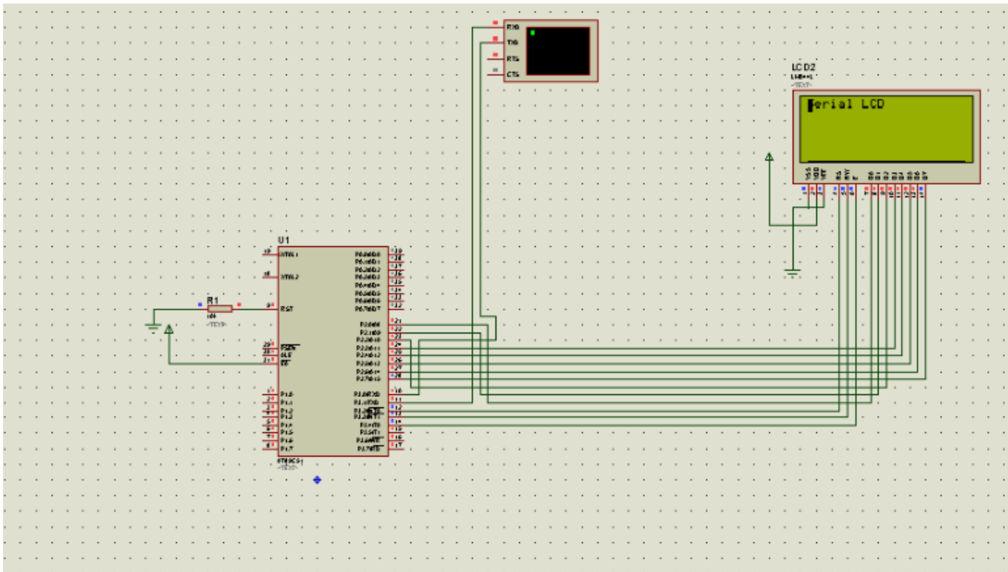

Figure 5.4.1 – control room circuit.

Conclusion

In this project our main motto is to provide safety environment for the scuba divers and swimmers. Liable and safe protocol has been introduced in this project for underwater wireless data transfer. And also cheap and easy and achievable techniques are used in this project. Ultraviolet radiation is used for underwater transmission at 40 kHz frequency. The ability of sonar sensor detecting range is 5m to 6m in this prototype. It can be exceed at the desirable and achievable range by using powerful equipments.

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Appendix

Data sheet

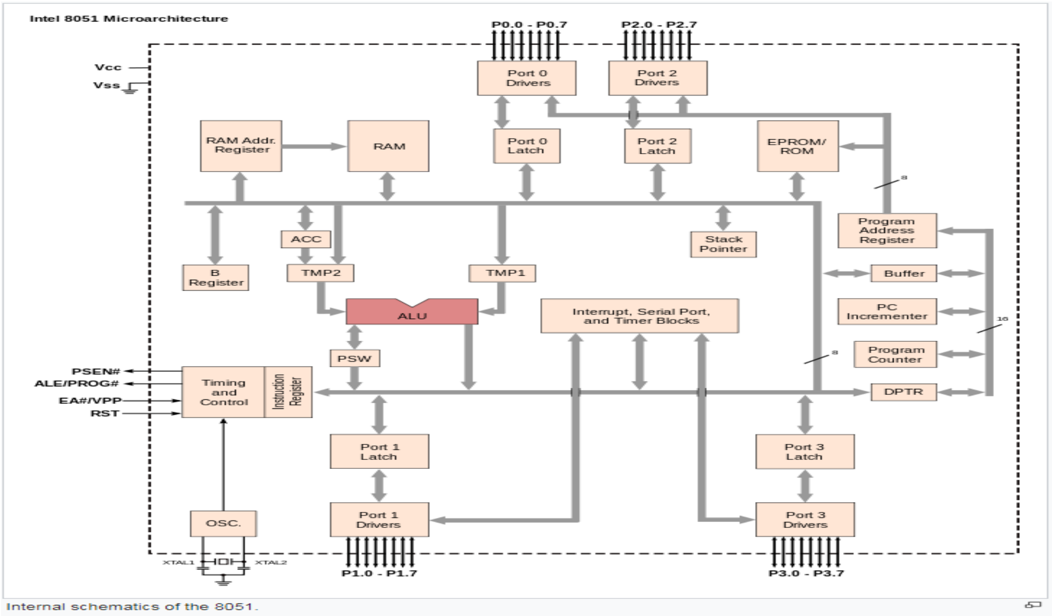

Figure-9 8051 Internal Architecture (datasheet)

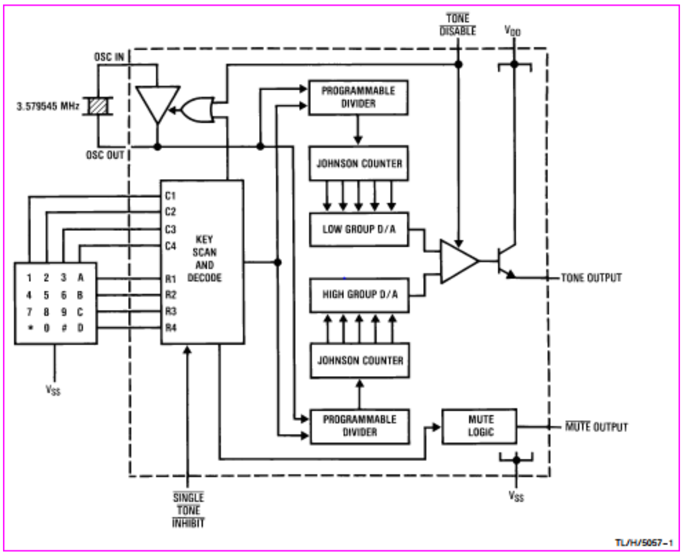

Figure-10 TP5089 block diagram (datasheet)

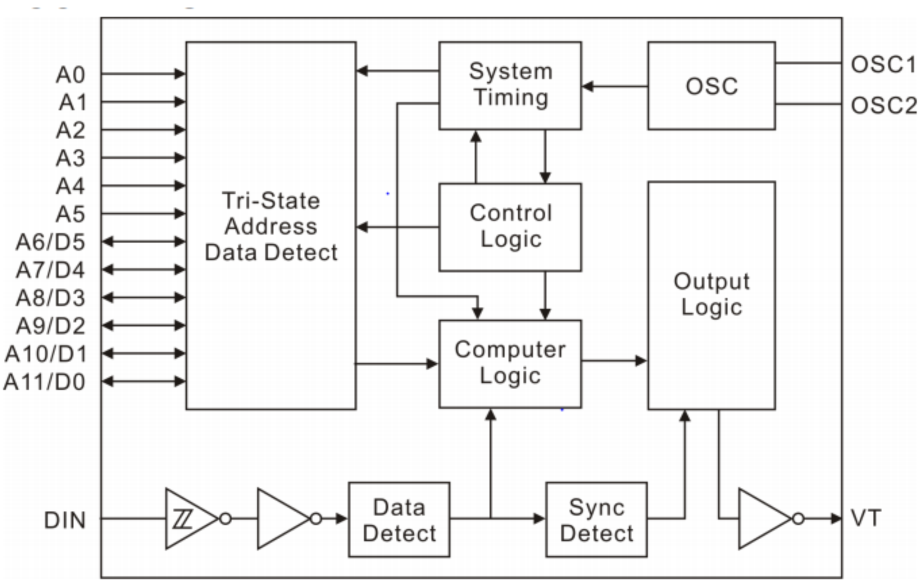

Figure-10 TP5089 block diagram (datasheet)

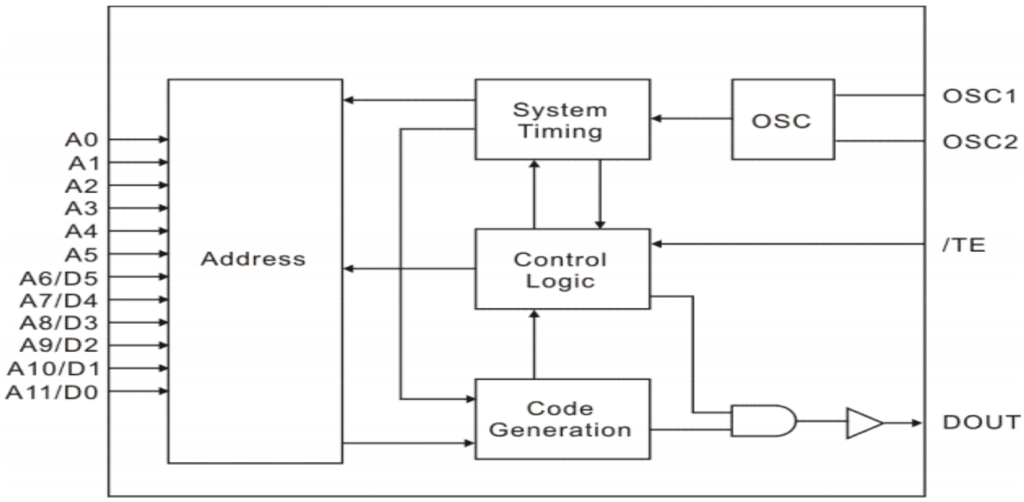

Figure-11 PT2262 block diagram (datasheet)

Microcontroller code:

```
#include <At89x52.h>

#include <stdio.h>

#define no_of_candidate 3

sbit clk=P1^7;
```

```
sbit reset=P1^6;
sbit Adress=P0^1;
sbit Active=P0^0;
sbit wrong_pass=P0^2;
sbit d1=P2^0;
sbit d2=P2^1;
sbit d3=P2^2;
unsigned long int timer_counter=0;
bit start_time=0;
bit dtmf_input_flag=0;
unsigned char DataCount;
bit keep_in_process=0;
bit time_over_flag=0;
bit check_password_ok=0;
bit check_password=0;
unsigned int dtmf_counter=0;
unsigned char array_d[3]={0,0,0};
unsigned char password_get=0;
unsigned char dtmf_byte=0;
```

```
unsigned long int wait_counter=0;

void InitSerial(void)

{


	SCON = 0x52;    // setup serial port control

	TMOD = 0x20;    // hardware (4800 BAUD @11.05592MHZ)

	TH1  = 0xFD;//0xFD;    // TH1

	TR1      = 1;                 // Timer 1 on

//	ES   = 1;          //seria port interrupt on

//	EA=1;

}

void wait()

{

for(wait_counter=0;wait_counter<=10000;wait_counter++);

for(wait_counter=0;wait_counter<=10000;wait_counter++);

for(wait_counter=0;wait_counter<=10000;wait_counter++);

for(wait_counter=0;wait_counter<=10000;wait_counter++);


}


void InitAll()

{



	 TMOD = (TMOD & 0xF0) | 0x01;  /* Set T/C0 Mode */
```

```
        ET0 = 1;                /* Enable Timer 0 Interrupts */
        TR0 = 1;
        IT0 = 1;   // Configure interrupt 0 for falling edge on /INT0 (P3.2)
    EX0 = 1;
        IT1 = 1;   // Configure interrupt 0 for falling edge on /INT0 (P3.2)
    EX1 = 1;            /* Start Timer 0 Running */
        EA = 1;                 /* Global Interrupt Enable */
        P2=0;
       // P3=0;
}//end initall

void Delay(unsigned int dl)
{
       unsigned int i;
       for(i = 0; i < 100; i++)
              //do nothing
              ;
}

void timer0_ISR (void) interrupt 1
{
TH0=0;
TL0=255;
clk=clk^1;
}
```

```
/////////////////////////////

void int0_isr (void) interrupt 0

{

                    reset=reset^1;

                    dtmf_byte=P1&0x0f;

                    switch(dtmf_byte)

                    {

                    case 1:{P2=1;P0=P0&0xfc;printf("junaid\r");}break;

                    case 2:{P2=2;P0=P0&0xfc;printf("moeed\r");}break;

                    case 3:{P2=4;P0=P0&0xfc;printf("muzammil\r");}break;


                    }


}

void int1_isr (void) interrupt 2

{



 reset=reset^1;

}

/////////////////////////////

void main()

{


InitSerial();
```

```
InitAll();

printf("the only sovereign is Allah\r");

P0=0;

        while(1)

        {


        }

}
```

LCD Code

```
void wrt_char(unsigned char ch)

{

  EN = 1;

  RW = 0;

  RS = 1;

  P2 = ch;

  EN = 0;

  wait_lcd();

}


void Send2LCD(unsigned char *Msg, unsigned char cp)

{

        unsigned char index;
```

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