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Application of Fuzzy Logic Technique for Oil Drilling Problem

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ABSTRACT

In this research paper, we studied a Decision making for Oil Drilling Problem using Fuzzy Logic Technique. In this problem, a geological engineer who has been asked by the chief executive officer (CEO) of a large oil firm to help make a decision about whether to drill the natural gas in a particular geographic region of northwestern new maxico. The first attempt at the decision process that there are only two states of nature regarding the existence of natural gas in the region. The CEO provides the utility matrix table. Further, CEO has asked you to collect new information by taking eight geographical boring samples from the region being considered the drilling. You have a natural gas expert examine the results of these eight tests; get the expert opinion about the conditional probabilities in the form of matrix.

For drilling problem, we have used two methods: Conditional probabilities for imperfect information & Conditional Probabilities of perfect information. From this method, we have calculated the expected utility, prior probabilities, conditional and unconditional probabilities of perfect and imperfect information and value of information is calculated. This totally fuzzy information and we have studied the value of fuzzy information which is less than the perfect and less than the imperfect information.

The problem of Oil Drilling Problem for Fuzzy logic technique is solved using the MATLAB programming software. This paper is totally based on software implementation of MATLAB.

Keywords : Oil drilling, Decision Making, Perfect, Imperfect Information And Uncertainty.

I. INTRODUCTION

1.1 Fuzzy Logic

The real world is complex , complexity arises from uncertainty in the form of ambiguity.“ as the complexity of the system increases , our ability to make precise and yet significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics.” These are the words of the LOTFI ZADEH who introduced fuzzy logic in 1965. “ The closer looks at a real world problem , the fuzzier becomes its solution”, observed Dr. Zadeh who published his seminal work “FUZZY SETS” in the journal or information and control.

When there is imprecision (more uncertainty) and inadequate data the fuzzy logic technique is useful.

Secondly, the cost of information increases with precision. But the cost of fuzzy information is far less than the perfect or imperfect information. Thus, there are two – fold advantages of the fuzzy logic technique: Understanding of complex systems becomes easier and analysis makes the system costs effective. He used the linguistic variable and further suggested that set membership function is the key to decision making when there is uncertainty.

The attention currently being paid to fuzzy logic is most likely the result of present popular consumer products such as washing machine, cameras, elevators, air conditioners, rice cookers, automobile, dishwashers etc. The nature of uncertainty in a problem is a very important point that engineers should ponder prior to their.

1.2 Fuzzificaion

Fuzzification is the process of making a crisp quantity fuzzy. We do this by simply recognizing that many of the quantities that we consider to be crisp and deterministic are actually not deterministic at all. They carry considerable uncertainty. If the form of uncertainty happens to arise because of imprecision, ambiguity or vagueness then the variable is probably fuzzy and can be represented by a membership function.

In the real world such as, digital voltmeter generates crisp data, but these data are subject to experimental error. The below fig 1.1 shows one possible range of errors for a typical voltage reading and associated membership function that might represent such imprecision

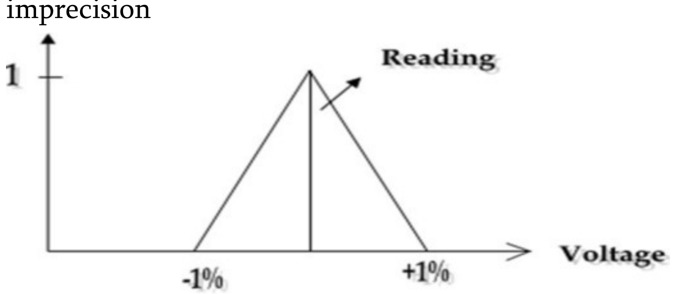

Fig 1.1 Membership function of crisp voltage reading

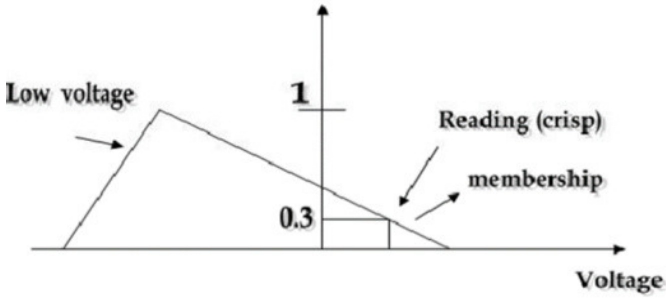

Fig.1.2 Fuzzy sets and crisp reading

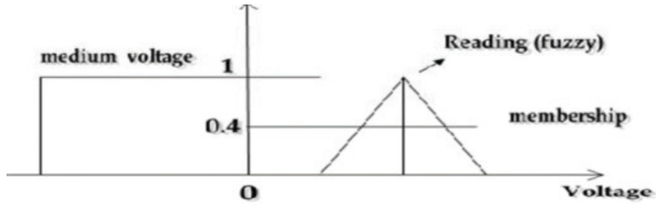

Fig. 1.3 Fuzzy set and fuzzy reading

1.3 Defuzzification

It is the conversion of fuzzy quantity to a precise quantity. The output of a fuzzy process can be the logical union of two or more fuzzy membership functions defined on the universe of discourse of the output variable.

Fig 1. 4 Block diagram of Fuzzy to Crisp Conversion

1.4 Oil drilling concept

A geological engineer who has been asked by the chief executive officer (CEO) of a large oil firm to help make a decision about whether to drill the natural gas in a particular geographic region of northwestern new maxico. The first attempt at the decision process that there are only two states of nature regarding the existence of natural gas in the region. The CEO provides the utility matrix table. Further, CEO has asked you to collect new information by taking eight geographical boring samples from the region being considered the drilling. You have a natural gas expert examine the results of these eight tests; get the expert opinion about the conditional probabilities in the form of matrix.

II. METHODOLOGY

For solving the oil drilling problem using fuzzy logic technique number of methods are available like Fuzzy Sets, Fuzzy relation, Cartesian product, alpha- cut, Non-transitive ranking methods etc. For oil drilling problem, we have two methods:

1) Conditional probabilities for imperfect information
2) Conditional probabilities of perfect information

From this method, we have calculated expected utility, maximum expected utility, prior probabilities, conditional and unconditional probabilities of perfect and imperfect information and value of the information calculated. This is totally fuzzy information which is less than the perfect and less than the imperfect information.

2.1. Nontransitive Ranking Method

When we compare objects that are fuzzy, ambiguous, or vague, we may well encounter a situation where there is a contradiction in the classical notions of ordinal ranking and transitivity in the ranking. To accommodate this form of nontransitive ranking, we introduce a special notion of relativity.

Let x and y be variables defined on universe X. We define a pairwise function fy(x) as the membership value of x with respect to y

And we define another pairwise function

fx(y) as the membership value of y with respect to x then the relativity function is given by

$f(x/y) = fy(x)/ \max[fy(x),fx(y)]$ (1)

is a measurement of the membership value of choosing x over y. The relativity function f(x/y) can be through of as the membership of preferring variable x over variable y.

To develop the genarl case for many variables, define variables x1,x2,------, xi,xi+1, ……,xn. All defined on universe X, and let these variables be collected in a set A i.e A= {x1,x2,……,xi-1,xi, xi+1, ……,xn}. We then define a set identical to set a except this new set will be missing one element xi, and this set will be termed A'. The relativity function then becomes

$f(xi/A') = f(xi/ \{x1,x2,\ldots,xi-1,xi, xi+1, \ldots,xn\})$

$= \min\{f(xi/x1), f(xi/x2),\ldots, f(xi/xi-1), f(xi/xi+1), \ldots,f(xi/xn)\}$ (2)

Which is fuzzy measurement of choosing xi over all elements in the set A'. The expression in equ(2) involves the logical intersection of several variables; hence the minimum function is used. Since the relativity function of the variable with repsect to itself is identity.

$f(xi/xi)=1$ (3)

then

$f(xi/A')= f(xi/A)$(4)

We can now form a matrix of relativity values. f(xi/xj), where i,j=1,2, n, and where xi and xj are defined on a universe X. This matrix will be square and of order n, and will be termed the c matrix (c for comaprision). The c matrix can be use to rank many different fuzzy sets.

To determine the overall rnking, we need to find the smallest value in each of the rows of the C matrix; that is,

$Ci' = \min f(xi/X)$, i= 1,2,…….,n. (5) Where Ci' is the membership ranking value for the ith variable.

III. EXPERIMENTAL WORK

Program:-

```
% s1 = there is natural gas
% s2=there is no natural gas
% prior probabilities for each state is p=inline('s1=0.5')
p=inline('s2=0.5')
syms ps1 ps2 uji s1 s2 a1 a2 px1 px2 ps1=0.5
ps2=0.5
% probabilities sum to unity
% There are two alternatives
```

% a1=drill for gas
% a2= do not drill for gas
% The CEO provides the utility matrix is given by U=[uji s1 s2;a1 4 -2;a2 -1 2]
u11=4 u12=-2 u21=-1 u22=2
% utility matrix for this situation U1=[4 -2;-1 2]
% the expected utility matrix is E1=ps1*u11+ps2*u12 E2=ps1*u21+ps2*u22
% maximum utility (E=E(u*)) E=max(E1,E2)

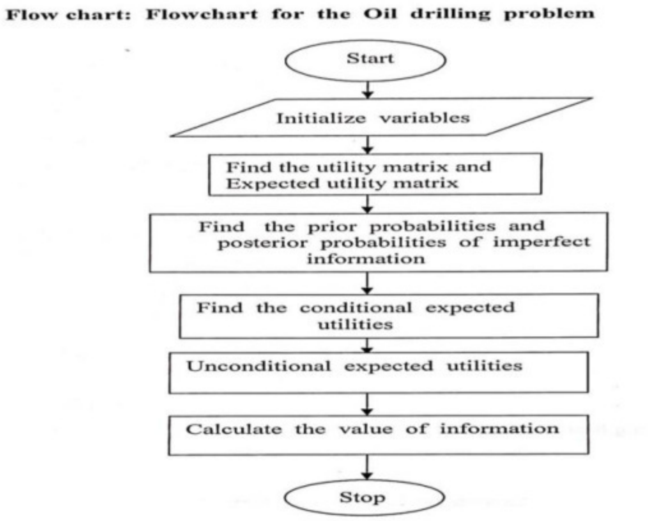

Fig 1.5 Flowchart for oil drilling problem

IV. RESULT AND DISCUSSION

In this example of the oil drilling problem, we studied about the large oil firm to help make a decision about whether to drill for natural gas in a particular geographical region. The prior probabilities geographical region. The prior probabilities of drilling information was

Ps1= p(s1) =0.5

Ps2 =p(s2) =0.5

The expected utility matrixes have been done by using utility matrix and prior probabilities. The eight geographical boring samples from the region have been considered for drilling. The table of imperfect and perfect information was very useful for this problem. The marginal probabilities for the new imperfect information, conditional probabilities, conditional expected utilities for imperfect and perfect information was studied. At last the values of new information have been calculated of both imperfect and perfect information. Some procedure will be happened in case of perfect information.

In this result, the fuzzy information was considered and fuzzy conditional probabilities have been derived. The fuzzy posterior probabilities P(Si/M) and fuzzy expected utilities E(uj/Mt) was done. The maximum conditional probabilities have been calculated and at last the fuzzy information calculated. The fuzzy information is less than the value of perfect information and less than the value of imperfect information. The result of imperfect information and perfect information is as shown in below table.

	X1	X2	X3	X4	X5	X6	X7	X8
p(s1/xk)	0	0.3333	0.2000	0.3333	0.6667	0.8000	0.6667	1.0000
p(xk/s2)	0.05	0.1	0.4	0.2	0.1	0.1	0.05	0
p(xk)	0.0250	0.0750	0.2500	0.1500	0.1500	0.2500	0.0750	0.0250
E(u*/xk)	2.0000	0.6667	1.2000	0.6667	2.0000	2.8000	2.0000	4.0000
aj/xk	a2	a2	a2	a2	a1	a1	a1	a1

Table 1. Posterior probabilities based on imperfect information

	X1	X2	X3	X4	X5	X6	X7	X8
P(s1/xk)	0	0	0	0	1	1	1	1
P(xk/s2)	0	0	0	0	1	1	1	1
P(xk)	0.05	0.1	0.25	0.1	0.1	0.25	0.1	0.05
E(u*/xk)	2	2	2	2	4	4	4	4
aj/xk	a2	a2	a2	a2	a1	a1	a1	a1

Table 2. Posterior probabilities based on perfect information

V. DISCUSSION

One area in which fuzzy set theory has a great potential that in psychology; in particular the psycho logistics which is essential for studying the connection between human communication and decision machines. Today, close to four decades after the artificial intelligence (AI) was born. It can finally be said that intelligent systems are becoming a reality. The soft computing has direct bearing on machine intelligence. Neuro fuzzy soft computing has a special role in the design of modern intelligent systems.

VI. APPLICATIONS OF FUZZY LOGIC

- Control systems
- Pattern recognition
- Robotics
- Consumer electronics
- Automobiles
- Intelligent systems

VII. FUZZY LOGIC IN CONSUMER GOODS

Cameras , Washing machine , Air conditioners , Luxury cars , Elevators , Rice cookers , Automobile , Dishwashers , Refrigerator , Camcorders , Vac. Cleaner etc.

VIII. SCOPE OF WORK

The scope of further research work is to develop and design some electronic circuits such as speed control motor, automatic control system and some decision making problem like weather forecast. This has been recently used for user-oriented verification of probability forecasts, but there is applied to aid forecast users in optimizing their decision making from probability forecasts.

IX. REFERENCES

[1]. Ross T J , “Fuzzy logic with engineering applications” , MGH,(1997.

[2]. Klir G J , “ Fuzzy sets , uncertainty, and information” , PHI, 2002.

[3]. J. E. Colgate and K. M. Lynch, “Mechanics and Control of Swimming: A Review,” IEEE Journal of Oceanic Engineering, vol. 29, pp. 660-673, July 2004.

[4]. R. Ramamurti and W. C. Sandberg, “Computational Fluid Dynamics Study for Optimization of a Fin Design,” In Proc. of the 24th AIAA , Applied Aerodynamics Conference, AIAA- 2006- 3658, San Francisco, CA, 2006.

[5]. Lee C. C, “Fuzzy logic in control systems”, IEEE Trans. On Systems, Man, and Cybernetics, SMC, Vol.20, No.2, 1990, pp. 404-35

[6]. Rudra Pratap, “MATLAB A quick Introduction for Scientist and Engineers”, Oxford University Press 2004

[7]. Bernardinis L A, “ Clear Thinking on Fuzzy Logic”, Machine Design, April 23, 199.

[8]. Engineering(An ISO 3297: 2007 Certified Organization ,Vol. 2, Issue 1, January 2014 p-p 2626-2631

[9]. system and simulation, , IACSIT Press, Singapore, pp. 92–95, Vol.7., 2011 [10]Cooper J A, “Fuzzy algebra uncertainty analysis for abnormal environment safety assessment”, J intelligent and fuzzy systems, January vol 3, issue 4, 337-346

Application of Fuzzy Logic for Decision Making in Remote Sensing Problem

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***Abstract*— Making decisions is undoubtedly one of the most fundamental activities of human being. We all come across with variety of alternate actions in our daily life which are available to us and at least in some instances; we have to decide which of the available actions to take. Decision making is the study of choosing alternatives options and identifying based on the preferences & best values of the decision maker. It is also a process sufficiently reducing uncertainty and doubt about alternatives to allow reasonable choice to be made from among them. It is most important scientific, social and economic endeavor. The remote sensing problem plays an important role in the data acquisition system. In this research, we studied an Application of Fuzzy Logic for Decision making in Remote Sensing Problem. Here, we have used a Multiobjective Decision making Method for solving a Remote sensing problem. From this method, we have calculated the expected utility, prior probabilities, conditional and unconditional probabilities of perfect and imperfect information and value of information is calculated.**

The problem of Decision making in Remote Sensing for Fuzzy logic technique is solved using the MATLAB programming software.

***Keywords*— Remote Sensing, decision making, Fuzzy Logic, Multiobjective.**

I. INTRODUCTION

1.1 FUZZY LOGIC

The real life is very difficult and complex, as the complexity of the life is increases , our potential to make precise and accurate statements about its behavior is reached beyond which precision and significance become almost exclusively characteristics. These are the super words of the Prof. Lotfi Zadeh who had introduced the fuzzy logic in 1965.

When there is more uncertainty and inaccurate data, the fuzzy logic method is very useful for solving problems. When the cost of information increases then the cost of fuzzy information is far less than the perfect or imperfect information. Thus, there are two most important advantages of the fuzzy logic technique: Understanding of difficult problems becomes easier and makes the system is very costs effective.

The fuzzy logic is most popular in consumer products such as Refrigerator, washing machine, elevators, air conditioners, cameras, rice cookers, automobile etc.

1.2 DECISION MAKING

Decision making is the selection and identifying the alternatives based on the preferences and important of values of the decision maker. It is also a process sufficiently reducing uncertainty and doubt about alternatives to allow reasonable choice to be made from among them. It is most important scientific, social and economic endeavor. To be make able to make consistent and correct choices is the essence of any decision process imbued with uncertainty.

In the decision making, there are number of alternative choices to be considered, and in case we have to choose the one that best fits with our desires, lifestyle, goals values and so on.

For Example:- A manager makes a good decision, but the outcome is bad and the manager gets fired. “A doctor uses the best established procedures in a medical operation and the patient dies; then the doctor gets sued for malpractice”. In all these situation the outcomes have nothing to do with the quality of the decisions or with the process itself. We have about the possible outcomes, about the value of new information, about the way of the conditions change with time (dynamic), about the utility of each outcome action pair, each action is typically vague, ambiguous and otherwise fuzzy.

1.3 BAYESIAN DECISION MAKING

In Many times, the decision makers have a general ability to find more information than required to make a best decision. When we want to decide a best decision among various options & alternatives, our choice is predicted on information about the future life, which is normally discretized into several "states of nature". If we knew with certainty the future states of nature, we would not need an analytic method to assess the likelihood of a given outcome.The future states of nature can be characterized as best probability events stated by Bayesian decision method. These are the words of "Thomas Bayes" an English clergyman and mathematician who set out his theory of probability in 1764. The Bayes theorem is quantifying uncertainty based on probability theory. This theorem defines a rule for refining an hypothesis by factoring in additional evidence and background information and this leads to a probability that the hypothesis is true. The decision analysis can indicate not only the best alternative to pursue, given the current problem description, but also weather a problem is ripe for deciding and, if not, how to proceed to reach that stage.

1.4 FUZZY DECISION MAKING

When the knowledge of the probabilities of the outcome states is unknown and the decision must be made under conditions of uncertainty then the fuzzy decision theory is used to accommodate this vagueness or ambiguity. The theories of classical decision making are:

1) Statistical decision theory (based on bayes' rule)
2) Mathematical (linear or non-linear) programming
3) Multi-criteria decision making

In Fuzzy decision making, the non-specificity inherent in human formulation of preference , vagueness are the common issues . The membership functions of fuzzy goals serve much the same purpose as utility or objective functions in classical decision making that order the outcomes according to prefer ability. When probabilities of the outcomes are not known, or may not even be relevant, and outcomes for each action are characterized only approximately we say that decisions are made under uncertainty. Fuzzy information is far less costly for precise information cost is far more as the precision increases cost becomes prohibit. But, if we have fuzzy information then fuzzy information takes less cost & still the conclusion drawn by using fuzzy logic will be less costly.

II. METHODOLOGY

Many simple decision processes are based on a single objective, such as minimizing cost maximizing profit, minimizing run time, and so forth. The two primary issues in multiobjective decision making are to acquire meaningful information regarding the satisfaction of the objectives by the various choices i.e. alternatives and to rank or weight the relative importance of each of the objectives. The typical multiobjective decision problem involves the selection of one alternative, ai , from a universe of alternatives A given a collection, or set, say {O}, of criteria or objectives that are important to the decision maker. We want to evaluate how well each alternative, or choice, satisfies each objective, and we wish to combine the weighted objectives into an overall decision function in some plausible way. This process naturally requires subjective information from the decision authority concerning the importance of each objective. Ordinal ordering of this importance are usually the easiest to obtain. Numerical values, ratios, and intervals expressing the importance of each objective are difficult to extract and, if attempted and then subsequently altered, can often lead to results inconsistent with the intuition of the decision maker.

To develop this calculus we require some definitions. Define a universe of n alternatives, A= {a1, a2, …….,an}, and a set of r objectives, O= {O1,O2,…..,Or}. Let Oi indicate the ith objective. Then the degree of membership of alternative a in Oi, denoted µOi(a), is the degree to which alternative a satisfies the criteria specified for this objective. We seek a decision function that simultaneously satisfies all of the decision objectives; hence, the decision function, D, is given by the intersection of all the objective sets,

D= O1UO2U∩…….∩Or…………………………………….(1)

Therefore, the grade of membership that the decision function, D, has for each alternative a is given by

µD(a) =min [µO1(a), µO2(a), ……, µOr(a)]…………………..(2)

The decision, a*, will then be the satisfies

µD(a*)= max(µD(a))
aεA

We define a set of preferences, {P}, which is constrained to be a linear and ordinal. The Elements of this Preference set can be linguistic values such as none, low, medium, high, absolute, or perfect; or they could be
values on the interval [0,1]. These preferences will be attached to each of the objectives to quantify the decision
maker's feelings about the influence that each objective should have on the chosen alternative.
The decision function, D, now takes on a more general form when each objective is associated with a weight expressing its importance to the decision maker. This function is represented as the intersection of r-tuples, denoted as a decision measure, M(Oi,bi), involving objectives and preferences.

D= M(O1,b1) ∩M(O2,b2)∩………∩M(Or,br)…………………………(3)

III. EXPERIMENTAL WORK

Here we describe a remote sensing problem which plays an important role in the data acquisition. In this example we use the multi-objective decision method to find the required output. And this problem is solved using MATLAB software.

For environmental modeling, remote sensing data play an important role in the data acquisition. Researchers must decide which type of sensor data best meet their preferences. Among the many alternatives sensors available, the list of candidates has been reduced to three: LANSAT7 (LS7), GOES (GS), and TERRA (TA). The researchers have defined four objectives that impact their decision:

1) cost of the data (COST)
2) time to deliver data (TIME)
3) Resolution of data collected (RES), and
4) Time for the sensor to return to the same spot cycle (CT)

In above objectives, there was some disagreement as to how to define the importance of each objective in the preference set so the researchers decided to define two sets of preferences, P1 and P2.

Alternatives: A = {LS7, GS, TA}
Objectives: O = {COST, TIME, RES, CT}
Preferences: P1 = {b1, b2, b3, b4} = {0.8, 0.4, 0.8, 0.7}
P2 = {b1, b2, b3, b4} = {0.4, 0.6, 0.4, 0.5}

The degree of membership of each alternative in the objectives is as follows;

O_1 = {0.2/LS7, 0.8/GS, 0.4/TA}
O_2 = {0.6/LS7, 1/GS, 0.2/TA}
O_3 = {1/LS7, 0.4/GS, 0.8/TA}
O_4 = {0.8/LS7, 0.7/GS, 0.2/TA}

PROGRAMMING IN MATLAB
PROGRAM 1: FOR THE FIRST PREFERENCE P1

```
% alternatives: A={LS7,GS,TA}
        % objectives : O= {COST, TIME, RES, CT}
        % preferences : P1={b1, b2, b3, b4}=
```

```
% O1={0.2/LS7, 1/GS, 0.4/TA}          objective 1
% O2={0.6/LS7,1/GS,0.2/TA}            objective 2
% O3={1/LS7,0.4/GS,0.8/TA}            objective 3
% O4={0.8/LS7,0.4/GS,0.2/TA}          objective 4
 P1=[0.8 0.4 0.8 0.7]   % P1={b1,b2,b3,b4}
P2=[0.4 0.6 0.4 0.5]   % P2={b1,b2,b3,b4}

   O1=[0.2 0.8 0.4]   % objective 1
   O2=[0.6 1 0.2]     % objective 2
   O3=[1 0.4 0.8]     % objective 3
   O4=[0.8 0.7 0.2]   % objective 4
   LS7=[0.2 0.6 1 0.8]      %  (LS7)
  GS =[0.8 1 0.4 0.7]      %  (GS)
  TA=[0.4 0.2 0.8 0.2]     %  (TA)
  P11 = 1-P1      % complement of P1 [P11]
 Da1=zeros(1,4)      % D(a1)=D(LS7)=Da1

for k=1:4
        if P11(1,k)>LS7(1,k)
             Da1(1,k)=P11(1,k)
     else
             Da1(1,k)=LS7(1,k)
             end
        end
        Da1=min(Da1)     %  minimum  of  Da1  over  alternative  a1
        Da2=zeros(1,4)         % D(a2)=D(GS)=Da2
        for k=1:4
              if P11(1,k)>GS(1,k)
              Da2(1,k)=P11(1,k)
     else
               Da2(1,k)=GS(1,k)
             end
       end
        Da2=min(Da2)     % minimum of  Da2  over  alternative  a2
        Da3=zeros(1,4)   % D(a3)=D(TA)=Da3
        for k=1:4
         if P11(1,k)>TA(1,k)
              Da3(1,k)=P11(1,k)
         else
             Da3(1,k)=TA(1,k)
        end
       end
       Da3=min(Da3)     % minimum of the Da3  over  alternative  a3
   Da1=0.2           % alternative  a1
   Da2=0.4           %  alternative  a2
   Da3=0.3            %  alternative  a3
   D1=[Da1 Da2 Da3]
  D1=max(D1)       %  maximum  of   all   alternatives
```

PROGRAM 2: FOR THE SECOND PREFERENCE (P2)

```
% alternatives: A= {LS7, GS, TA}
% objectives: O={COST, TIME, RES, CT}
```

```
% preferences: P1={b1, b2, b3, b4}

% O1={0.2/LS7, 1/GS, 0.4/TA}        objective 1
% O2={0.6/LS7, 1/GS, 0.2/TA}        objective 2
% O3={1/LS7, 0.4/GS, 0.8/TA}        objective 3
% O4={0.8/LS7, 0.4/GS, 0.2/TA}      objective 4

P1= [0.8 0.4 0.8 0.7]        % P1={b1, b2, b3, b4}
P2= [0.4 0.6 0.4 0.5]        % P2={b1,b2,b3,b4}

  O1=  [0.2 0.8 0.4]            % objective 1
  O2=  [0.6 1 0.2]              % objective 2
  O3=  [1 0.4 0.8]              % objective 3
  O4=  [0.8 0.7 0.2]            % objective 4

  LS7=  [0.2 0.6 1 0.8]      %(LS7)
  GS =  [0.8 1 0.4 0.7]      %(GS)
  TA=  [0.4 0.2 0.8 0.2]     %(TA)

  P22=1-P2            % COMPLEMENT OF P2
 DA1= zeros(1,4)     % D(A1)=D(LS7)=DA1

 for k=1:4
   if P22(1,k)>LS7(1,k)
    DA1(1,k)=P22(1,k)
else
    DA1(1,k)=LS7(1,k)
end
 end
DA1=min(DA1)     % minimum of  DA1  over  alternative  A1

DA2=zeros(1,4)                % D(A2)=D(GS)=DA2
 for k=1:4
   if P22(1,k)>GS(1,k)
   DA2(1,k)=P22(1,k)
 else
    DA2(1,k)=GS(1,k)
 end
  end
DA2=min(DA2)     % minimum of  DA2  over  alternative  A2

  DA3=zeros(1,4)   % D(A3)=D(TA)=DA3
 for k=1:4
   if P22(1,k)>TA(1,k)
   DA3(1,k)=P22(1,k)
 else
   DA3(1,k)=TA(1,k)
  end
  end
DA3=min(DA3)     % minimum of DA3  over  alternative  A3

DA1=0.6         % D(a1)=D(LS7)=DA1
DA2=0.6         %D(a2)=D(GS)=DA2
```

```
 DA3=0.4          % D(a3)=D(TA)=DA3
D2=[DA1 DA2 DA3]    % it will be written down in row wise matrix
D2=max(D2)        % D2=maximum of D2
```

PROGRAM 3:

```
DA1=0.6          % D(a1)=D(LS7)=DA1
DA2=0.6           %D(a2)=D(GS)=DA2
DA3=0.4          % D(a3)=D(TA)=DA3
D2=[DA1 DA2 DA3]    %  in row wise matrix
D2=max(D2)        % D2=maximum of D2
% But there is a tie between alternative A1 A2
p2=[0.4 0.6 0.4 0.5]
O1=[0.2 0.8 0.4]      % O1={0.2/LS7,0.8/GS,0.4/TA}
O2=[0.6 1 0.2]       % O2={0.6/LS7,1/GS,0.2/TA}
O3=[1 0.4 0.8]       % O3={1/LS7,0.4/GS,0.8/TA}
O4=[0.8 0.7 0.2]      % O4={0.8/LS7,0.7/GS,0.2/TA}
          LS7=[0.2 0.6 1 0.8]      %(LS7)
          GS =[0.8 1 0.4 0.7]      %(GS)
          TA=[0.4 0.2 0.8 0.2]     %(TA)
P22=1-P2        % complement of P2
% To remove  the  terms from  the  alternatives  A1  and  A2  of  0.6
DA11=zeros(1,1)     % D^(a1)= DA11= D^(LS7)
      if P22(1,4)>LS7(1,4)
             DA11(1,1)=P22(1,4)
           else
             DA11(1,1)=LS7(1,4)
           end
 DA11=min(DA11)      %  minimum  of  DA11
DA22=zeros(1,2)      % D^(a2)=DA22=D^(LS7)
      if P22(1,2)>GS(1,2)
      DA22(1,1)=P22(1,2)
    else
      DA22(1,1)=GS(1,2)
      end
     if P22(1,4)>GS(1,4)
      DA22(1,2)=P22(1,4)
     else
      DA22(1,2)=GS(1,4)
      end
      DA22=min(DA22)
    D3=[DA11 DA22]
    D3=max(D3)
```

IV. RESULT AND DISCUSSION

In this example of the Remote Sensing problem, we studied about the role of a decision in a data acquisition System.

OUTPUT: 1

```
P1 = 0.8000    0.4000    0.8000    0.7000
P2 =0.4000    0.6000    0.4000    0.5000
O1 = 0.2000    0.8000    0.4000
O2 = 0.6000    1.0000    0.2000
```

O3 =1.0000 0.4000 0.8000
O4 = 0.8000 0.7000 0.2000
LS7 = 0.2000 0.6000 1.0000 0.8000
GS = 0.8000 1.0000 0.4000 0.7000
TA =0.4000 0.2000 0.8000 0.2000
P11 = 0.2000 0.6000 0.2000 0.3000
Da1 =0.2000 0.6000 1.0000 0.8000
Da1 = 0.2000
Da2 = 0.8000 1.0000 0.4000 0.7000
Da2 = 0.4000
Da3 = 0.4000 0.6000 0.8000 0.3000
Da3 =0.3000
D1 =0.2000 0.4000 0.3000
D1 =0.4000

OUTPUT : 2

P1 = 0.8000 0.4000 0.8000 0.7000
P2 = 0.4000 0.6000 0.4000 0.5000
O1 = 0.2000 0.8000 0.4000
O2 = 0.6000 1.0000 0.2000
O3 = 1.0000 0.4000 0.8000
O4 = 0.8000 0.7000 0.2000
LS7 = 0.2000 0.6000 1.0000 0.8000
GS = 0.8000 1.0000 0.4000 0.7000
TA = 0.4000 0.2000 0.8000 0.2000
P22 = 0.6000 0.4000 0.6000 0.5000
DA1 = 0.6000 0.6000 1.0000 0.8000
DA1 = 0.6000 % minimum of DA1
DA2 = 0.8000 1.0000 0.6000 0.7000
DA2 = 0.6000 % minimum of DA2
DA3 = 0.6000 0.4000 0.8000 0.5000
DA3 = 0.4000 % minimum of DA3
D2 =0.6000 0.6000 0.4000
D2 = 0.6000

OUTPUT 3:

DA1 = 0.6000
DA2 = 0.6000
DA3 = 0.4000
D2 = 0.6000 0.6000 0.4000
D2 = 0.6000
p2 = 0.4000 0.6000 0.4000 0.5000
O1 = 0.2000 0.8000 0.4000
O2 = 0.6000 1.0000 0.2000
O3 = 1.0000 0.4000 0.8000
O4 = 0.8000 0.7000 0.2000
LS7 = 0.2000 0.6000 1.0000 0.8000
GS = 0.8000 1.0000 0.4000 0.7000
TA = 0.4000 0.2000 0.8000 0.2000
P22 = 0.6000 0.4000 0.6000 0.5000
DA11 =0

DA11 = 0.8000
DA11 = 0.8000
DA22 =0 0
DA22 =1 0
DA22 =1.0000 0.7000
DA22 =0.7000
D3 =0.8000 0.7000
D3 =0.8000

In the example of remote sensing, the many alternative sensors were available such as LANSAT 7, GOES (GS) and TERRA (TA). These were all alternatives which were collected in A. The objectives were COST, TIME, and RESCT. We assume that, preferences P1 and P2. P11 is complement of P1 and P22 is complement of P2. The Intersection and Union has been taken of preferences P11 and objectives O1, O2, O3, and O4. The result was stored in Da1, Da2, and Da3 and taken the maximum value among all alternatives which contain the Da2 is the maximum value. Same procedure will be happened in case of preference P2 and maximum value was taken out and maximum value was DA1 and DA2. But this problem shows the same value. Therefore, there was a tie between them. To remove this tie, we were reduce the term which contain the result in DA11 and DA22 and the maximum of that value given the result of actual value that shows the final result.

REFERENCES

[1] Ross T J .; Fuzzy logic with engineering applications , MGH,(1997).
[2] Klir G J .; Fuzzy sets , uncertainty, and information , PHI,(2002).
[3] J. E. Colgate and K. M. Lynch, "Mechanics and Control of Swimming: A Review" vol. 29, pp. 660-673, July 2004.
[4] R. Ramamurti and W. C. Sandberg, "Computational Fluid Dynamics Study for Optimization of a Fin Design", AIAA-2006- 3658, San Francisco, CA, (2006).
[5] Lee C. C, 20, "Fuzzy logic in control systems", *IEEE Trans. On Systems, Man, and Cybernetics, SMC, Vol.20, No.2,* 1990, pp. 404-35.
[6] Rudra Pratap, "MATLAB A quick Introduction for Scientist and Engineers", Oxford University Press (2004).
[7] Bernardinis L A, "Clear Thinking on Fuzzy Logic", *Machine Design*, April 23, (1999).
[8] Engineering(An ISO 3297: 2007 Certified Organization , (2014) 2626-2631.
[9] System and simulation, , *IACSIT Press, Singapore (*2011)*,* 92–95.
[10] Cooper J A, "Fuzzy algebra uncertainty analysis for abnormal environment safety", J intelligent and fuzzy systems, January vol 3, issue 4, 337-346.
[11] K.Y.Rokde, S.M.Ghatole P.B.Dahikar, M.J.Hedau, S.S.Shende , "Study of Fuzzy Logic Technique for Power Transistor Problem" ,vol 1, Issue 1, pp 22-88, apr 2016.

DESIGN AND IMPLEMETATION OF LOW COST BLOOD PRESSURE & BODY TEMPERATURE MONITORING SYSTEM USING WIRELESS TECHNOLOGY

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Abstract
The objective of this research work is to design and implementation of a non-invasive, accurate, and low cost biomedical sensor interface for processing and monitoring blood pressure and body temperature using wireless technology. In present development, the real time blood pressure biomedical signal is measured using an optical measurement circuit based plethysmography technique(PPG) continuously monitor the systolic and diastolic blood pressure for a long period of time & Body temperature is dealt with a LM35 sensor. The detected measured signal amplified using an operational amplifier circuit and interface with the microcontroller. The numerical reading values of systolic and diastolic blood pressure remotely recorded and displayed with the help of LCD and stationary computer.
Key Words: Blood Pressure ,Body temperature, Wireless, Non-invasive, monitoring system etc.

I. INTRODUCTION

"Health is Wealth", is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research.

Knowing the physical status of a person is very important for understanding the body condition of a person. Vital signs that play an important role for understanding the condition of human system are heart rate, temperature and blood pressure of a person. In this method we had made use of three sensors LM35,, blood pressure sensor which has the sensing element as SPD100G.

A. Blood Pressure:

Blood pressure is the most often measured and most intensively studied parameter in medical and physiological practice. Pressure measurements are a vital indication in the sucessful treatment and management of critically ill patients in an intensive cardiac care unit or the patients undergoing cardiac catheterisation.

The meaurement of BP are of great importance because it is used for detection of hypertension (high blood pressure). Hypertension is a continuous, consistent, and independent risk factor for developing cardiovascular disease. Hypotension can cause the blood supply to the brain, heart and other tissues to be too low, and hypertension is strongly correlated with higher risk for cerebral stroke and heart infarct. Blood pressure measurement is also important for particular disease patients, such as hemodialysis patients. Hence, in the daily life, blood pressure measurement and management is very useful for handling health situation and plays a preventive function.

B. **Temperature:** Temperature is measured using LM35 sensor. The human body temperature is measured by placing hand on the sensor LM 35 it reads the value and gives an ADC value which is converted to the Celsius degrees

II. METHODOLOGY

A. Photoplethysmography Unit (PPG):-

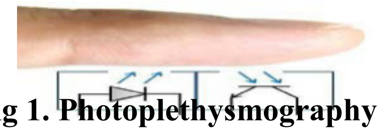

Fig 1. Photoplethysmography Technique

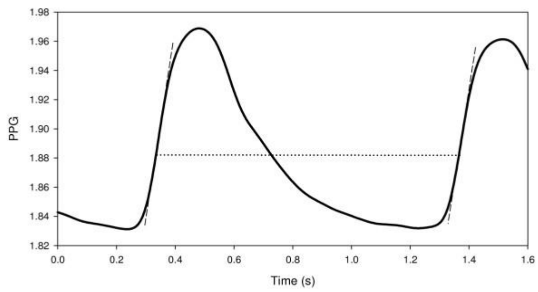

Fig 2. PPG Waves

pressure monitors are based on oscillometric method accepted and widely used mobility, they require suitable for home-care and long-term monitoring of BP for homecare inexpensive method that is and does not require These requirements can be which will be designed using technique. method used to measure volume in the tissues. It utilizes contains an infrared light a part of the tissue photo-detector receives the obtained from this technique which can be used to is shown in fig. 1 where used as the source and a phototransistor is used as the detector.

More to the point, a developed technique based on a noninvasive continuous blood pressure measurement using volume oscillometric method and photoplethysmograph technique has been investigated , and the study uses high intensity LED and a LDR (Light Dependent Resistor) and placed them at the edge of a finger. The concept is that the resistance of the LDR changes according to the light intensity received by the LDR. The change in resistance is proportional to the change of blood volume and as well as blood pressure in the finger. The result showed the systolic and diastolic blood pressure on a mini LCD. In addition, a non-invasive blood pressure monitor was developed using photoplethysmograph method.

B. Body Temperature

The body temperature is measured by LM35, a precision integrated-circuit temperature sensor whose output value is proportional to the Celsius temperature. It's a three pin IC where we have supply output and ground connections

Temperature is a measure of the degree of heat intensity. The temperature of a body is an expression of its molecular excitation. The temperature difference between two points indicates a potential for heat to move from the warmer to the colder point. The human body's core temperature varies from day to day, and from time to time, but these fluctuations are small, usually no more than 1.0ºC. Humans are homoeothermic and body temperature is regulated at about 37ºC ±1ºC. The thermoregulatory center in the hypothalamus plays a very active role in keeping body temperature in the normal range. External and internal heat sources influence body temperature.

LM35 generates higher output voltage than thermocouples and may not require that the output voltage be amplified. The scale factor is 0.01V/**OC.**LM35 does not require any external calibration or trimming and maintains an accuracy of 0.4C at room temperature and 0.8c over a range of 0 to 100.

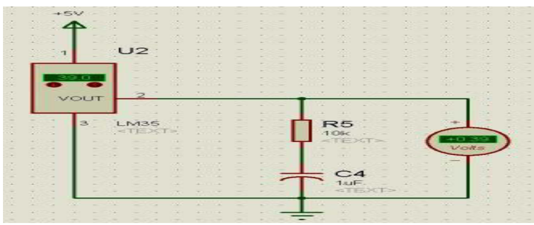

Fig 3. Temperature sensor circuit

III. EXPERIMENTAL WORK

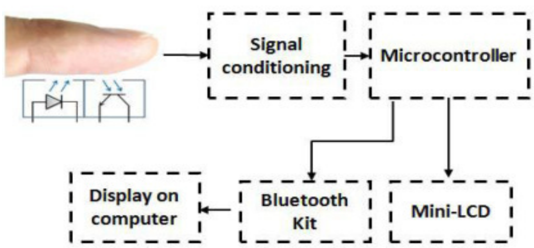

Fig 4. Circuit diagram of system.

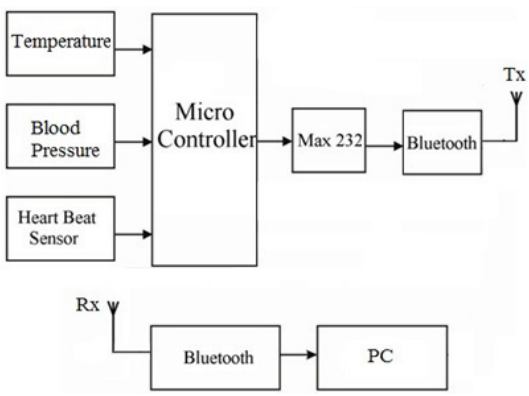

Fig 5. Blood Pressure and Body temperature monitoring

A. Sensing Stage

The detection of the blood pressure signal is based on using optical measurement technique called photoelectric plethysmography (PPG). This technique has the ability to detect the volume of blood pressures in the arteries. The PPG basic form utilizes two components: a light source to illuminates a part of the tissue (e.g. fingertip) and a photo detector to receive the light. Transparency of living tissue to light makes it possible for some part of the light from the source to pass through the tissue to the photo-detector.

However, some part of the light is absorbed by the blood, bone, muscle and skin in the tissue. The volume of the blood in the vessel varies while the volume of other part remains constant. Therefore the light absorption is varied only by the change of volume of blood (increases or decreases) and the returning light to the photo-detector changes according to the change of blood volume. The electrical resistivity of the photo-detector changes depending on the amount of light falling on it. This change of resistivity results is the change of electrical current flowing in the detector which is converted into PPG signal.

Fig 6. Optical Sensor

The LM35 temperature sensor is proposed in this work for measuring the human body temperature. It is a precision integrated circuit Temperature Sensor which is small and can be placed anywhere on the body.

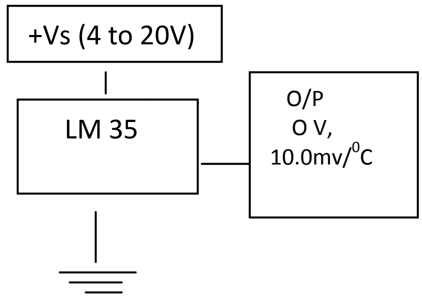

Fig 7. Temperature sensor

The LM35 output voltage is linearly scalable to the measured temperature, which is 10 mV per 1 degree Celsius as shown in fig 8. So if Vout = 0.37V then the measured temperature is 37°C. It does not require external calibration and maintains an accuracy of ±0.4°C at room temperature and ±0.8°C over a range of 0°C to +100°C [26,

A. Signal Conditioning Stage:

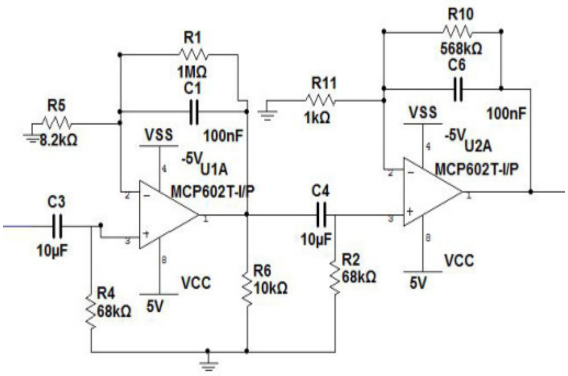

Fig 8 . Circuit Diagram

After the sensor detected the changes in the volume of blood pressures, a low frequency and low magnitude biopotential signal is received by the photodiode. As the detected PPG signal is so weak, it must undergo some signal conditioning (e.g. amplifying and filtering) so that it can be used for further processing. Since the output voltage of the photo-detector has a large amount of dc component which requires a filter to suppress out the dc component. A good filter choice will be the use of an active bandpass filter because its first cut off frequency can be used to remove direct current (DC) and its second cutoff frequency can be used to remove unwanted high frequency components in the signal like power line interference (50 Hz). In addition, the filter is also used with a very high gain for amplifying the signal. Two stage bandpass filter are used and each stage has different gain.

B. Microcontroller Stage:

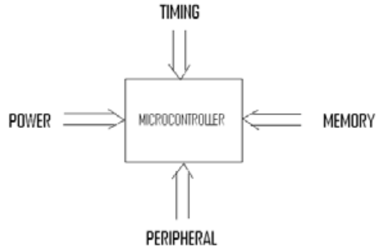

Fig.9 Essential block of microcontroller requirement (PIC18F252)

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. The output of the signal conditioning stage is fed into a microcontroller where it is processed (sampling and quantizing). The PIC18F252 microcontroller is used in this system where it has a built-in ADC. The PIC18F252 device family can operate at speeds up to 12MIPS and has a hardware multiplier for faster calculation of control algorithms. The microcontroller finds out the smallest (represents DBP) and the largest (represents SBP) value form the output voltage using a program written in MPLAB X IDE.

The microcontroller then displays the measured blood pressure information in mini LCD and transmits them through a Bluetooth device to any stationary enabled computer device. Buzzer alert of the system helps the patient itself to be aware of his/her condition and can take necessary steps towards medication. At the same time, physician can also diagnose the patient from a remote location as system provides SMS alert at critical situations. The Bluetooth interface provides a convenient and low power consumption method for data transmission. This system provides users an easy-to-interface interface and simple blood pressure management environment.

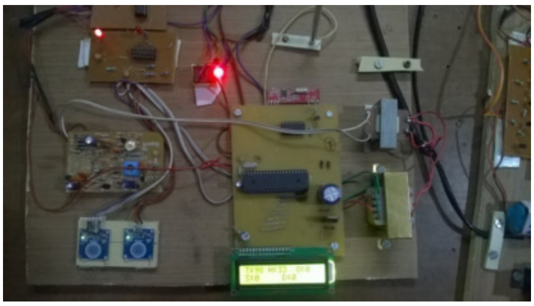

Fig . 10 Experimental Work

D. LCD (Liquid Crystal Display) with Driver.

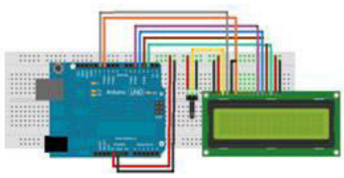

Fig 11 . LCD (Liquid Crystal Display)

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

E. Bluetooth Technology

By using Bluetooth (SKKCA-21) Remote Control. SKKCA-21 module offers simple yet compact Bluetooth platform for embedded applications. It has a surface mount layout which makes the process of development and application easier. The Bluetooth transmits the reading to the PC equipped with Bluetooth. The display on computer is acquired using special software called Parallax-Serial-Terminal. It is simple terminal software which allows users to display results through predefined serial ports.

F. RF Transceiver Module.

Fig.12 RF Module

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

IV. RESULT AND DISCUSSION

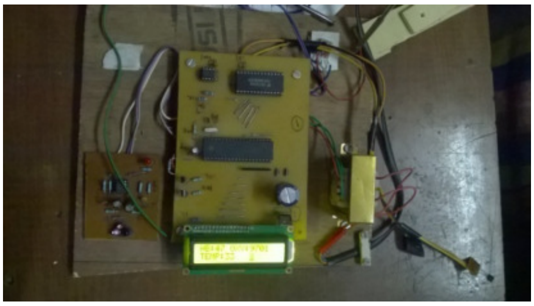

Fig 13. Circuit Result

This system monitors the blood pressure and the temperature in the PC screen by using the Bluetooth technology. This entire system requires less power which can even implemented in remote (mobile) patients too. We can add some another parameters as per our necessary.

When the power is turned on, all the LEDs on PCBs starts glowing, indicating that circuit is working properly. Here there is a use of the industrial temperature sensor i.e. LM 35 which gives us room temperature in °C. That temperature is displayed on the LCD.

Age	Gender	PPG(reading)
20	Female	79
26	Female	78
38	Male	84
56	Male	65
60	Male	70

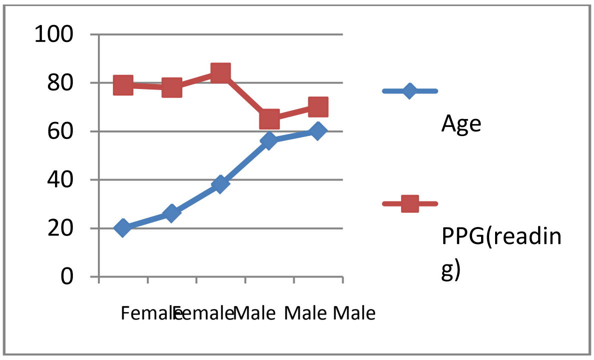

Fig. 14 Graph in between Age, Gender and PPG readings.

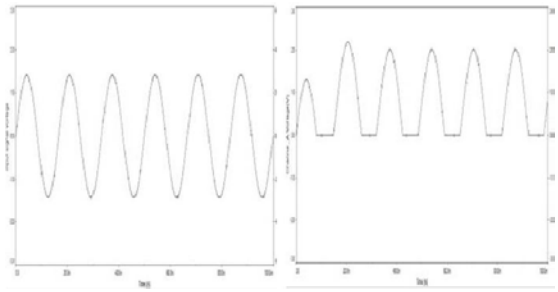

Fig. 15 Input and output waveform of amplifier in Multisim

V. CONCLUSION

With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The small embedded system can display the systolic and diastolic blood pressure on a mini LCD as well stationary computer which is a Bluetooth enabled device though Bluetooth wireless technology. In case of any abnormal changes in the blood pressure readings, the system alerts using a buzzer and it also send a message to the predefined number(i.e. a physician number) using GSM. Furthermore, the obtained results will be compared with existing devices data like a sphygmomanometer to verify the accuracy of the developed instrument. This system provides users an easy-to-use interface and simple BP management environment. The Bluetooth interface provides a convenient and low-power consumption method for data transmission. This work may further be extended in future to include more number of physiological parameters like heart rate, oxygen saturation, respiration rate etc. to be monitored for a long period of time. GPS system can be used to spot the exact position of the patient and thus can provide immediate help if required.

V. FUTURE SCOPE

The Scope of research work intended to design and construct an blood pressure and body temperature measurement using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

The device can be connected to PC by using serial output so that measured heartbeat and temperature can be sent to PC for further online or offline analysis.

Warning for abnormalities of health condition can be displayed.

Sound can be added to the device so that the device makes a sound each time a pulse is received and alarm is started for abnormal health condition.

The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.

More parameters (like blood pressure) can be added to

VI. REFERENCES

1. Ayala Kenneth J."The 8051 Microcontroller", Published By Penram International (India), Second we3
2. Dougherty Kelvin M.," Analog To Digital Conversion" A Practical Approach, Mc-Graw Hill, Inc.
3. Hall D.V,"Microprocessor & Interfacing Programming Hardware", Tata Mc-Grow-Hill Edition, 1991, Seventh Reprint1995.
4. Mazidi Muhammad Ali, Mazidi Janice Gillispie,"The 8051 Microcontroller And Embedded Systems" Published By Pearson Education (Singapore) Pvt. Ltd, First Edition
5. Khan, F. and Bilgainya, R., Synthesis and characterization of metal and metal oxide sponges using Triton X-165 as sacrificial template. Indian J. Chem. A, 2011, 55–59.
6. S.S.Shende, P.B.Dahikar2, MJ.Hedau3, K.Y. Rokde4 International Journal of Innovative Research in Computerand Communication Engineering(An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 1, January 2014 p-p 2626-2631
7. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Wireless Signal Simulation Via Cell-Phone "International Conference on circuit system and simulation, , pp. 92–95, Vol.7, IACSIT Press, Singapore, 2011
8. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Microcontroller in Technical communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588Vol.5Issue 1,2012.
9. P. B. Dahikar M. J. Hedau, S. C. Moholkar "Application of Microcontroller in Receiving Unit of the Technical Communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588 Vol.5 Issue 2, 2012.
10. K.Y.Rokde, Dr. P.B.Dahikar2, Dr. M.J.Hedau3, S.S.Shende 4 International Journal of Innovative Research in Computer and Communication Engineering(An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 9, September 2014 p-p 2320-9798.
11. Sandeep Banka, Anitha Marry X, International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE), ISSN 0976-1353 Volume 8 Issue 1 –APRIL 2014.
12. Md. Shamsul Arefin, Tajrian Mollick," International Journal of Scientific & Engineering Research", ISSN 2229-5518, Volume 4, Issue3, March-2013, IJSER © 2013.
13. Basem Abu Zneid[1], Mohammed Al-zidi[1], Tareq Al-kharazi," IEEE region 10 symposium, " april 2014,PP- 248-253, Kaula Lumpur, Malaysia.
14. Johevajile K.N Mazima, Michael Kisangiri, Dina Machuve, International Journal of Emerging Science and Engineering (IJESE) ISSN: 2319–6378, Volume-1, Issue-10, August 2013.
15. Harshavardhan B. Patil*, Prof. V. M. Umale, Int. Journal of Engineering Research and Applications(IJERA), ISSN : 2248-9622, Vol. 5, Issue 4, (Part -4) April 2015, pp.46-48.
16. P. Vignesh, E. Sathya, International Journal of Science and Research (IJSR), ISSN (Online): 2319-7064 Impact Factor (2012): 3.358.

National Conference on "Recent Trends in Mathematical Modeling, Simulation Methods, Computations, and Physical Sciences"
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Application of Manifold Sensors in Wireless Digital Thermometer

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ABSTRACT

This paper describes the application of a manifold sensors in wireless digital thermometer for measuring temperature from different sensors using single wireless digital thermometer. In this paper primarily temperature sensor LM35 is used. ADC0808 is used to convert analog signal obtained from temperature sensor into digital format so that the special parallel to serial encoder will transmit the signal using Tx module to remote receiving end. At the receiving end the transmitted signal is received by receiver module. Reverse action is carried out on the signal to what happed at the transmitting end and temperature detected by sensor is displayed on digital multi-meter on mV scale.

Keywords: Temperature Sensor, ADC, Encoder

I. INTRODUCTION

Temperature is certainly among the most commonly measured parameters in industry, science, and academia. Recently, the growth of wireless instrumentation technology, along with some clever innovations, has provided new ways to apply temperature measurement sensors combined with personal computers to collect, tabulate, and analyse the data obtained.

Wireless monitoring system is, as their name suggests, monitoring systems that can be installed without the need to run cabling or wires. Wireless monitoring systems are the ultimate in quick, easy and neat monitoring installation solutions. Because they are wireless they are very discreet and unobtrusive, there is no buildings' decoration spoiling nor is there an unsightly wire highway on wall surfaces. Wireless monitoring systems are more convenient than hard wired systems and it means that even the most unlikely places can have a wireless monitoring a system installed and in a fraction of the time.

Temperature measurement in today's industrial environment encompasses a wide variety of needs and applications. To meet this wide array of needs the process controls industry has developed a large number of sensors and devices to handle this demand. Temperature is a very critical and widely measured variable for most applications. Many processes must have either a monitored or controlled temperature. The paper deals with measurement of temperature using temperature sensor LM35. In all eight LM 35 sensors are been used in the current work.

II. METHODOLOGY

Temperature measurement can be done using temperature sensor LM35 but the problem arises when one has to measure more than one temperature at a time. To overcome this problem an approach has been shown in the paper to sense temperature from eight sensors at a time.

At the transmitting end, we have temperature sensor LM35, ADC 0808, Encoder HT12E2, Sequential Data Selector and Transmitter Module. An 8 bit ADC continuously scans and converts signals from eight different temperature sensors. The sensors are selected sequentially by a 3 bit binary addressing system. At any instant of time an 8 bit ADC generates an 8 bit binary number equivalent to the analog signal obtained at the output of a particular temperature sensor, being selected by 3 bit binary addressing system. By using special parallel-to-serial encoders, this 8-bit data, along with the binary address of the sensor, is sent serially to the remote receiving end. Communication between the two ends are met with the help of a pair of 433MHz UHF transmitter and receiver modules operating in ASK/OOK mode. At the receiving end, the transmitted signal is received by a 433MHz ASK/OOK RF receiver module. The received 8-bit serial signal is then converted back to its original parallel form, by using special data decoders HT 12E. An equivalent analogue signal is then developed from this data by an 8-bit digital-to-analogue converter (DAC). A digital multimeter connected at the output of the DAC is used to show the temperature on mV scale.

III. EXPERIMENTAL SETUP & WORKING

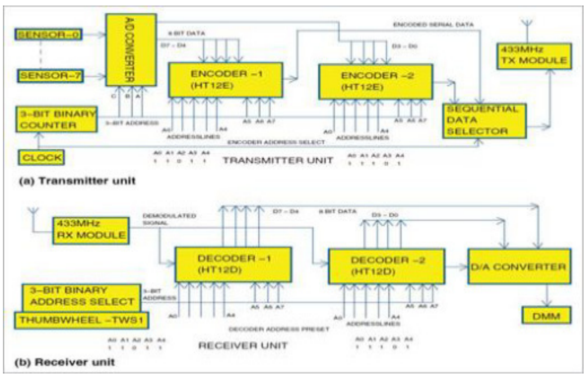

Figure 1. Block Diagram Of Manifold Sensors In Wireless Digital Thermometer

Figure **1.a** shows the block diagram of the transmitter unit for the wireless addressable digital thermometer. Eight LM35 IC temperature sensors are connected to ADC 0808. Although the ADC is capable of accepting a total number of eight sensors through its eight input lines, less number of sensors could be used as well as, whenever desired. IC 7404 configured as a CMOS oscillator with the help of resistors and capacitor feeds the ADC with necessary clock pulses required for conversion processes.

Output voltage of LM35 series IC temperature sensors follows linearly (@10mV/°C) the centigrade temperature of its surroundings, taking 0mV at 0°C temperature. The ADC continuously scans its eight input lines. The scanning process is governed by a 3-bit binary up counter built around CD4029. The counter places a continuously-changing 3-bit binary number on A-B-C input lines of the ADC. Scanning rate is dependent upon the clock constructed around timer NE555, and is 8Hz, approximately. Hence, each of the eight sensors is allowed to send data to the ADC for approximately one-eighth of a second, irrespective of whether all sensors are connected or not.

Here, IC 0808 is configured in continuous operational mode. So, whenever a particular sensor is addressed, output lines of the ADC reflect the present analogue output status of the sensor. Output of the ADC goes to data input lines of special encoders HT12E; higher nibble to first HT12E and lower nibble to second HT12E, respectively. As TE input of encoders is permanently grounded, the encoders are configured to produce encoded data continuously. These two encoded digital outputs are alternately steered to TX1 (TX-433MHz), a UHF RF transmitter module, to modulate UHF carrier wave generated by the module.

Encoder output: Whenever IC 555 output pulse goes high, output of HT12E is steered to TX1 through diode. At the same time, due to the presence of transistor inverter, output of HT12E is inhibited to reach TX1 through the gate. As soon as the clock pulse returns to logic 0, output of HT12E gets its passage to TX1 through gate of 7408.

So, in essence, analogue data of a sensor is converted and the resultant 8-bit digital data is sent to the remote end using ASK/OOK modulation, in a complete clock cycle of IC 555.

Modulated signal is radiated into space through a wire, acting as an antenna, connected at the antenna point of the module.

Figure **1.b** shows the receiving unit of the wireless addressable digital thermometer. RX1, a 433MHz RF receiver module, is used to receive and demodulate ASK-modulated RF signal transmitted by TX1 of the transmitter unit. Demodulated output is a train of rectangular pulses comprising a 4-bit data nibble and destined for a particular decoder as explained earlier. Transistor BC547 is used as a pulse amplifier to amplify the signal output from RX1 and, hence, raises the pulse height to CMOS compatible logic -1 (>3.5V at 5V). This compatible output is then fed to CMOS NAND gate 4011. NAND gate helps to get pulses of perfect rectangular-wave shape. Output of IC 4011 is fed to decoders HT12D. Address lines of the decoders are preset to receive data from two encoders HT12E, respectively.
LEDs connected at their outputs flicker to indicate reception of valid data. Decoding speed is 200kHz (approximately). Decoded data is then fed to DAC 0808. Analogue current output of the DAC is loaded. Voltage developed across it is fed to a digital multimeter, which shows the temperature on mV scale. A thumbwheel switch is used to change the preset address of the decoders. The switch changes the last three LSB of the address.

III. RESULT AND DISCUSSION

Table 1. Temperature recorded by different techniques and deviation

Sr. No	Actual	Experimental	Deviation
1.	37.4	37.2	0.2
2.	37.6	37.3	0.3
3.	37	37.1	-0.1
4.	36.8	36.9	-0.1
5.	37	36.8	0.2
6.	36.5	36.3	0.2
7.	37.5	37.3	0.2
8.	36.7	36.4	0.3
9.	37.5	37.3	0.2
10.	36.9	37	-0.1
11.	37.2	37	0.2
12.	37.6	37.4	0.2
13.	36.7	36.9	-0.2
14.	36.8	36.5	0.3
15.	37.5	37.3	0.2
16.	36.9	37	-0.1
17.	37	37.2	-0.2
18.	37.3	37.1	0.2
19.	37.4	37.2	0.2
20.	36.5	36.3	0.2

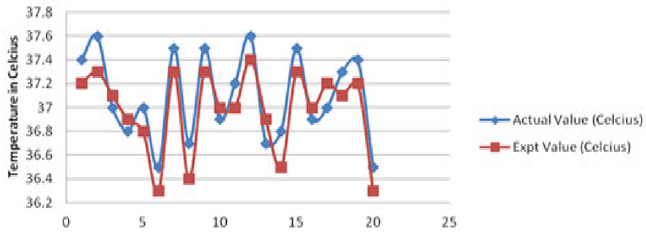

Figure 2. Graph representing the comparison of data for Temperature by different techniques.

For proper operation of this wireless thermometer, reference current (to pin 4 of DAC0808) of the receiver unit should be pre-adjusted. To do this, follow the steps below:

Connect a known voltage source (not exceeding +5V) to any input of the ADC, say, at pin 4 of the ADC.

Switch on the transmitter unit. Connect a DMM across Resistor of the receiver unit. Set the range switch to DC 200mV range, positive lead to ground and negative lead to top of Resistor. Switch on the receiver unit. LEDs at decoder outputs should start glowing to indicate the received voltage data. If source voltage is 1.5V, status of LEDs should be as listed in Table I. So, received voltage = (D× 5)/256 = (76×5)/256 = 1.50 where D is the weight of the binary numbers represented by LED7 through LED14. Now, adjust trim potmeter to get 150.00mV on the dial of the multimeter. Connect another voltage source at the input and see that the multimeter shows it correctly. If required, re-adjust the trim potmeter. After proper calibration, enclose the circuit in two separate boxes with suitable connections of input and LED indicators.

STATUS OF LEDS IN THE RECEIVER UNIT

LED	7	8	9	10	11	12	13	14
Data	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Weight	128	64	32	16	8	4	2	1
Status	OFF	ON	OFF	OFF	ON	ON	OFF	OFF

IV. CONCLUSION

Although the system can be used best to measure temperatures in hazardous or inaccessible areas (like a radioactive zone), the same can also be used by a hospital doctor to monitor, from a fixed location, the body temperatures of multiple patients lying in different rooms without visiting each patient in person.

A hotel control room can monitor temperatures of all the rooms at the same time by using multiple units. The unit can also be used (with certain modifications) as a wireless digital voltmeter.

V. REFERENCES

[1]. https://electronicsforu.com/electronics-projects/wireless-digital-thermometer-multiple-sensors

[2]. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Wireless Signal Simulation Via Cell-Phone "International Conference on circuit system and simulation, , pp. 92–95, Vol.7, IACSIT Press, Singapore, 2011.

[3]. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Microcontroller in Technical communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588Vol.5Issue 1,2012.

[4]. P. B. Dahikar M. J. Hedau, S. C. Moholkar "Application of Microcontroller in Receiving Unit of the Technical Communication" International Journal of ETA and ETS, IACSIT ISSN No 0974-3588 Vol.5 Issue 2, 2012.

[5]. S.S.Shende, P.B.Dahikar, M.J.Hedau, K.Y.Rokde, "Alternative Technique to perform Surgeries in Hospital by Surgical Diathermy" International Journal of Innovative Research in Computer and Communication Engineering- IJIRCCE", of ISSN number is 2320-9798 on Vol.2, Issue 1, 2014.

DESIGN AND DEVELOPMENT OF AN EMBEDDED SYSTEM FOR AUTOMATIC BLOOD PRESSURE MONITORING

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Abstract-
This paper presents a design and development of an Embedded System for Automatic blood pressure Monitoring. The real-time blood pressure biomedical vital signal is measured using an optical measurement circuit based Plethysmography technique (PPG) continuously for a long period of time. The blood pressure sensing system will give the diastolic and systolic pressure reading on the display. The automatic Blood pressure numerical reading values of systolic and diastolic blood pressure calculated is then displayed on a LCD. For measurment of BP a special BP sensor MPS 3117 and BP pump is used. The result is calculated and then it is sent to central location system using RF module. The results were compared with existing devices data as a Sphygmomanometer technique to verify the accuracy of the developed instrument.

Key Words:- Blood Pressure, Embedded, Wireless, photoplethysmography, LCD etc.

I. INTRODUCTION

Blood pressure measurement is one of the basic clinical examinations. The origin of blood pressure is the pumping action of the heart and its value depends on the relationship between cardiac output and peripheral resistance. Therefore, blood pressure is considered as one of the most important physiological variables with which to assess cardiovascular hemo-dynamics.
It is the force created by the heart as it pushes blood into the arteries through the circulatory system. Each time the heart contracts or “beats” the blood is pumped out and creates a surge of pressure in the arteries. Blood pressure is the force exerted by circulating blood on the walls of blood vessels.

Blood pressure is the most often intensively studied parameters in medical and physiological practice. The determination of only its maximum and minimum levels during each cardiac cycle supplemented by information about other physiological parameters is a valuable diagnostic aid to access the vascular condition and certain other aspects to cardiac performance. Blood is pumped by the left side of the heart into the aorta, which supplies it to the arterial circuit. Due to the load resistance of the arterioles and the precapillaries, it losses most of its pressure and returns to the heart at low pressure vie highly distensible veins. The right side of the heart pumps it to the pulmonary circuit, which operates at lower pressure. The heart supplies blood to both circuits as simultaneous intermittent flow pulses of variable rate and volume. The maximum pressure reached during cardiac ejection was called systolic pressure and the minimum pressure occurring at the end of ventricular relaxation is termed as diastolic pressure. The mean arterial pressure over one cardiac cycle is approximated by adding one third of the pulse pressure (difference between systolic and diastolic values) to the diastolic pressure.[1]

II. METHODOLOGY

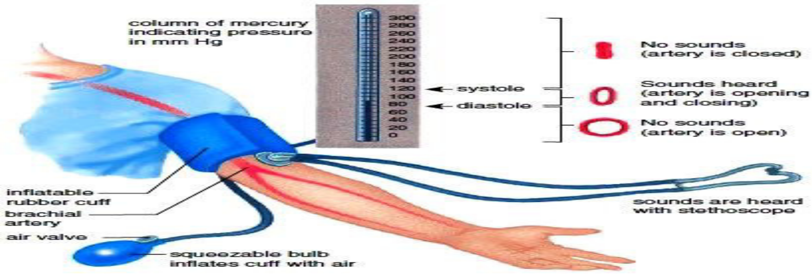

Fig 2.1 Blood pressure Measurement using Sphygmomanometer

A Sphygmomanometer worked on the principle that when the Cuff was placed on the upper arm and was inflated, the arterial blood flowed past the Cuff only when the Arterial Pressure exceeds the Pressure in the cuff. When the Cuff was inflated to a Pressure that occluded the Brachial Artery only partially, turbulence was generated in the blood as it spurted through the tiny arterial opening during each Systole. The sounds generated by the turbulence, Korotkoff sounds, was heard through a Stethoscope placed over the Artery downstream from the Cuff.[2]

III DETAIL ANALYSIS OF SENSORS USED

A. Variations in Blood Pressure

Normal BP for adults is defined as 120/80 mmHg. But this changed with different activities and due to various reasons. The measurements were different when the person was asleep, awake, active, nervous or excited. Once the activity stopped, BP returned to the baseline range. Blood Pressure normally rose with age and body size. Newborn babies often had very low Blood Pressure numbers, considered normal for babies, while older teens had numbers similar to adults.

Approximate Age (in years)	Systolic mmHg	Diastolic mmHg	Heart Rate per min	Respiratory Rate per min
1 – 11 (months)	74-100	50-70	120-160	30-60
1 - 3	80-112	50-80	90-140	20-40
4 - 5	80-110	50-78	90-140	22-34
6 - 12	84-120	54-80	75-100	18-30
13 - 18	94-140	62-88	60-90	12-16

Table 1. Common Range of BP, Respiratory Rate and Heart Rate in Children

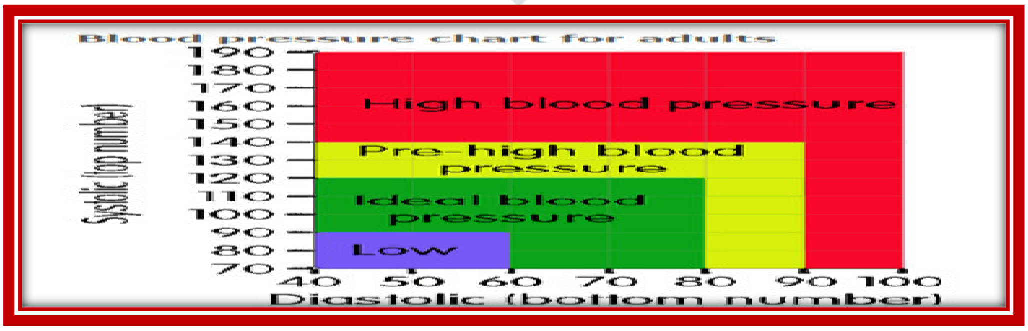

Fig 3.2 Blood Pressure Chart for Adults

B. Blood Pressure sensor

In choosing the sensor for the blood pressure monitoring device many sensors were considered. Many factors were taken into account including the voltage input range for operation, current range for operation, as well as what is actually being sensed. Blood pressure through electronic means was often done in an indirect method in which information was derived from a signal and information known about signals and pressure. Therefore what is actually being sensed directly is not blood pressure. The signal received from the sensor starts as a mechanical signal and a transducer changes it into a voltage to be fed into a processor for deducting information.For the Circuit design we have used a MPS 3117 sensor.

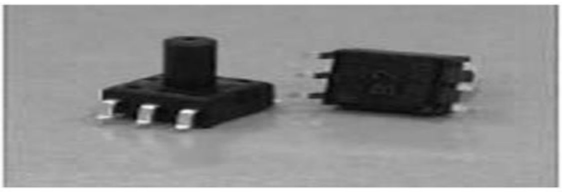

Fig 3.3 Blood pressure sensor MPS-3117

The MPS-3117 pressure sensor from Taiwan Metro dyne System Corporation, utilizes a special case of the Wheatstone bridge, the Wien Bridge which was driven by a constant current source of 1mA to 3mA and requires 2-5V of supply voltage. Utilizing the Wien Bridge allows the capacitance of two capacitors to be compared because the resistance values of the circuit were known. The pressure sensor was therefore able to send the double-ended output differential signals depending on profile of the air pressure wave. The signal was an analog mixed signal with an output voltage in the range of 0-40mV that is proportional to the differential input mechanical air pressure.[3]

C. BP pump and Motor

Fig 3.4 BP pump

Product Description

- Mini Air Pump 6V
- Air flow: 1liters per minute to 2.2liters per minute.
- Current: Under 100mA to 600mA
- Volt: DC 6V
- Power consumption: about 2.4W.
- Noise: Under 55DB
- Can work with WV120-6V solenoid valve the keep pressure and release pressure

D. Cuff

The cuff is an integral part of the blood pressure is normally placed smoothly and snugly around an upper arm, at roughly the same vertical height as the heart while the subject is seated with the arm supported. It is essential that the correct size of cuff is selected for the patient. When too small a cuff results in too high a pressure, while too large a cuff results in too low a pressure, so it comes in four sizes, for children up to obese adults. Also, it is made of a non-elastic material, and the cuff used is about 20% bigger than the arm. The cuff is inflated until the artery is completely occluded. Then, the sensor takes action sensing the brachial artery at the cuff; the microcontroller controls the valve which slowly releases the pressure in the cuff. As the pressure in the cuffs falls, a pulsation sound is heard when blood flow first starts again in the artery. The pressure at which this sound began was known and recorded as the systolic blood pressure. Furthermore, the cuff pressure was further released until the sound can no longer be heard. This was recorded as the diastolic blood pressure. There were two main blood pressure flows such as systolic blood pressure and diastolic blood pressure. Below are the definitions of each blood flow.

Systolic blood pressure - is the amount of pressure that blood exerts on vessels while the heart is beating. In a blood pressure reading (such as 120/80), it is the number on the top.

Diastolic blood pressure – is the pressure in the bloodstream when the heart relaxes and dilates, filling with blood. In a blood pressure reading (such as 120/80), it is the number on the bottom.

Fig 3.5 D ring Cuff

D-ring cuffs come in different sizes of small, standard and large. It was important to pick out the right size cuff based on your individual arm circumference. Expandable Cuff was a pre-formed upper arm cuff that expands to fit both regular and large sized arms. It was designed to ensure more comfortable, accurate readings. There was a reasonable standard expandable D-Ring cuff which had a circumference between 9” to 13” – 22 to 32 cm which was being used for this research work. It was very important to use the appropriate size cuff for your arm in order to get accurate measurement results when using your home blood pressure monitor. If you use the wrong sized cuff, you were likely experiencing inaccurate readings, inconsistent readings and error messages from the device. To determine the arm size, we used a cloth tape measure and place midway between the elbow and the shoulder around the circumference of the upper arm.[4]

IV. EXPERIMENTAL WORK

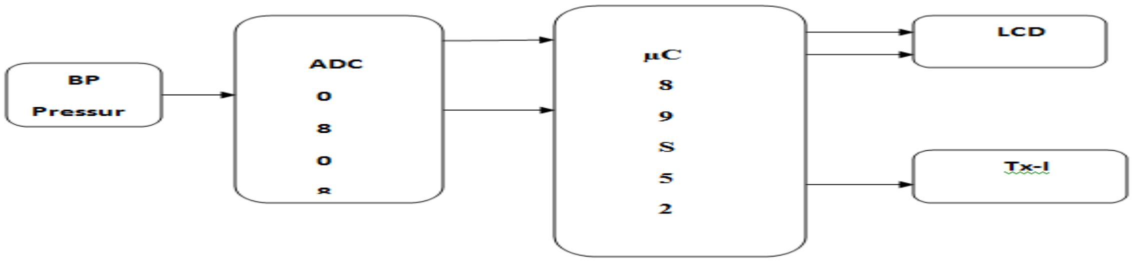

Fig 4.1 Block diagram BP system

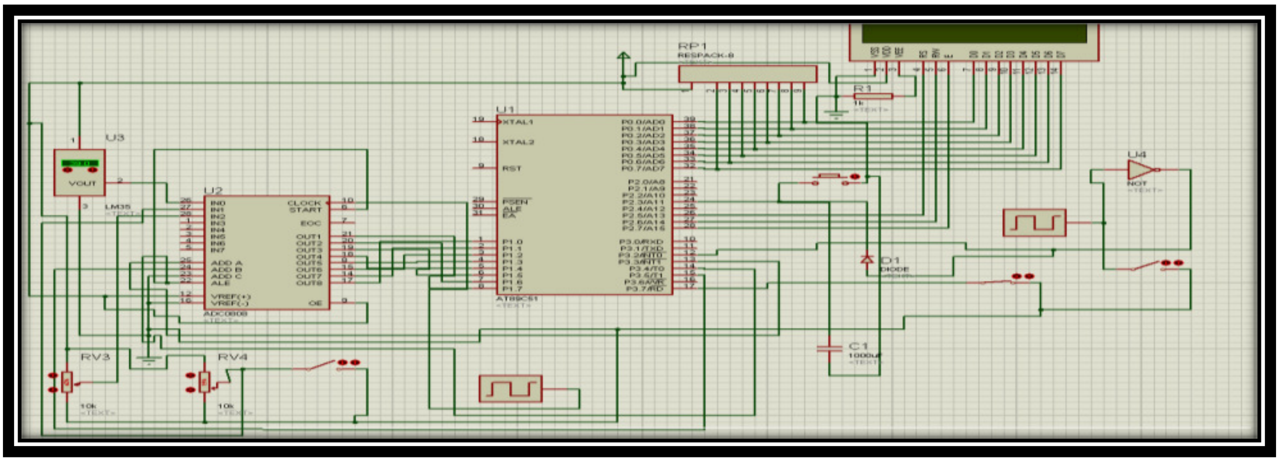

Fig 4.2 Circuit diagram of BP Measuring system

ADC 0809 is used to convert analog signals from temperature sensor, and pressure sensor to digital values to read by microcontroller. Heart beats are monitored in any digital pin of microcontroller. Here we are using pin 12 of microcontroller. A switch is provided to measure the BP. In this mode only BP will be measured and the values are stored in memory. And by changing position of switch all parameters will be measured and send to receiver. Data pins of ADC are connected to pin 1 to 8 of microcontroller. Select pin 25 of ADC is connected to pin 13 of microcontroller for selecting channnels. Pin 24 is connected to pin 16 of microcontroller. And third select pin is grounded. Start of convertion pin 6 and 22 are shorted and used as start of convertion and is connected to pin 14 of microcontroller.clock at pin 10 is provided by IC555, and this IC is used as astable multivibrator.and provide 20KHz clock. LCD data pins are connected to pin 32 to 39 of microcontroller. RS pin is connected to pin 26 of microcontroller, RW pin is connected to pin 27 and Enable pin to pin 28 of microcontroller.

Microcontroller measures Temperature then pressure from pressure sensor in BP switching. And then measure the pulse stop to pump motor. And measure higher blood pressure. And when again pulse atarts that time it measures lower pressure. The data will be continiously transmitted using RF transmitter. The parameters measured are displayed on LCD display

A. BP amplifier circuit

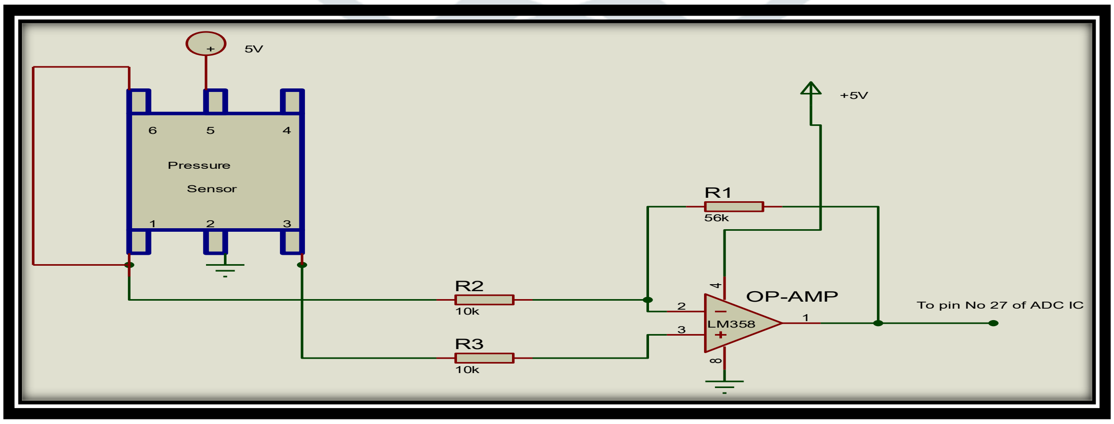

Fig 4.3 BP amplifier Circuit

Fig 4.4 Hardware ckt of BP Amplifier Ckt

The signals from pressure sensor were very weak so it was necessary to amplify the signals to read by ADC. So for this we were used an op- amp circuit constructed with LM 368 IC. The inputs from sensor were connected to pin 2 and pin 3 of this op-amp IC. Amplification factor was selected by using 96K resistor connected at pins 2 and pin 1 of this IC so at the output amplified signals were available and it was connected to pin 27 of ADC to read pressure.

B. Microcontrollers: (AT 89S52)

A microcontroller is a dedicated computer in electronics that was used to perform specific tasks. For the purpose of this research, a microcontroller was used because, besides being a low-power device, it has a low cost and it was designed to be as compact as possible. The microcontroller would take input from the device that it was controlling and it would be sending signals constantly to different components of the device so it performs the desired tasks. Among all the microcontrollers available at the market, the research uses the 89S52.

It is a Low-power, high-performance CMOS 8-bit microcontroller with 8KB of ISP flash memory. The device uses Microchip high-density, nonvolatile memory technology and is compatible with the industry-standard 89S52 instruction set and pinout. On-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. This powerful microcontroller is suitable for many embedded control applications.

In this research work the Embedded C language programming is done in microcontroller IC 89S52 to controlling the Blood pressure. The software aspects i.e Proteus and Ride software is used for designing and programming.

V. RESULT AND DISCUSSION

The Systolic and Diastolic Blood Pressure for Seventy two different patients were recorded using the designed hardware instrument and were compared with the values obtained by standard means. The values recorded were tabulated and is shown in the tables given below.

BP - Systolic			
Sr No	Patients Data		Deviation
	Standard Device	Experimental Measures	
1	80	77	3
2	81	79	2
3	83	79	4
4	85	80	5
5	86	85	1
6	88	72	6

7	89	85	4
8	92	91	1
9	93	93	0
10	95	91	4
11	96	97	-1
12	98	93	5
13	98	96	2
14	100	102	-2
15	102	97	5
16	103	98	5
17	104	103	1
18	106	106	0
19	108	102	6
20	113	107	6
21	116	114	2
22	118	120	-2
23	124	121	3
24	126	125	1
25	126	127	-1
26	129	125	4
27	130	128	2
28	134	131	3
29	138	132	6
30	141	141	0
31	143	139	4
32	143	142	1
33	144	139	5
34	145	143	2
35	146	147	-1
36	146	145	2
37	148	140	8
38	149	147	2
39	150	144	6
40	152	143	9
41	152	148	4
42	154	154	0
43	155	145	10
44	157	150	7
45	158	153	5
46	160	161	-1
47	162	159	3
48	162	163	-1
49	163	160	3
50	164	160	4
51	165	161	4
52	166	163	3
53	168	168	0
54	168	166	2
55	169	161	8
56	170	166	4
57	171	175	-4
58	173	167	6
59	173	172	1
60	174	168	6
61	176	178	-2
62	177	171	6
63	178	174	4
64	180	172	8
65	180	178	2

66	184	182	2
67	185	180	5
68	186	180	6
69	188	174	14
70	189	196	-7
71	192	186	6
72	192	193	-1

Table 2 .BP- Systolic data Recorded by Different Means and the Deviation

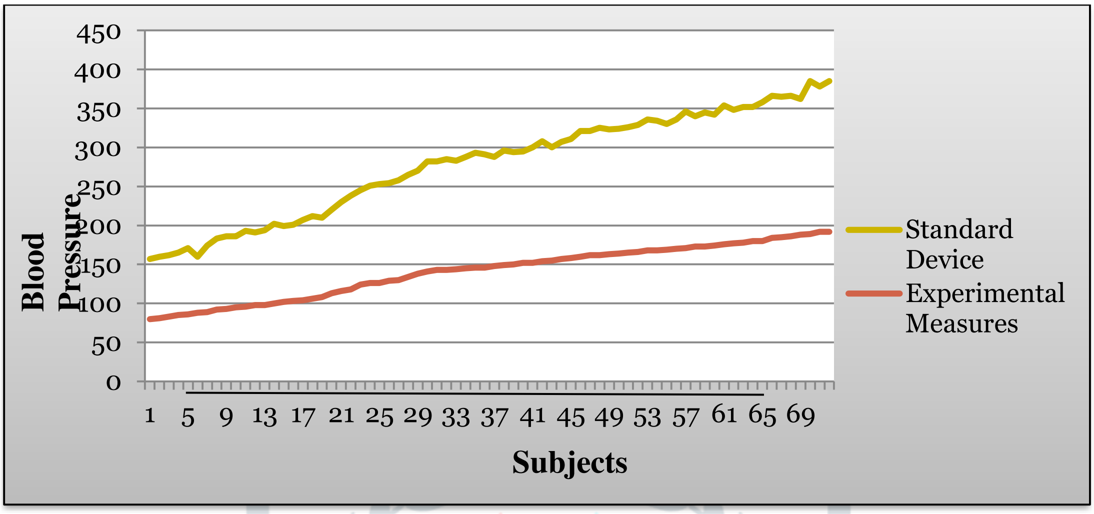

Fig 5.1 Plot Showing the BP for Various Patients

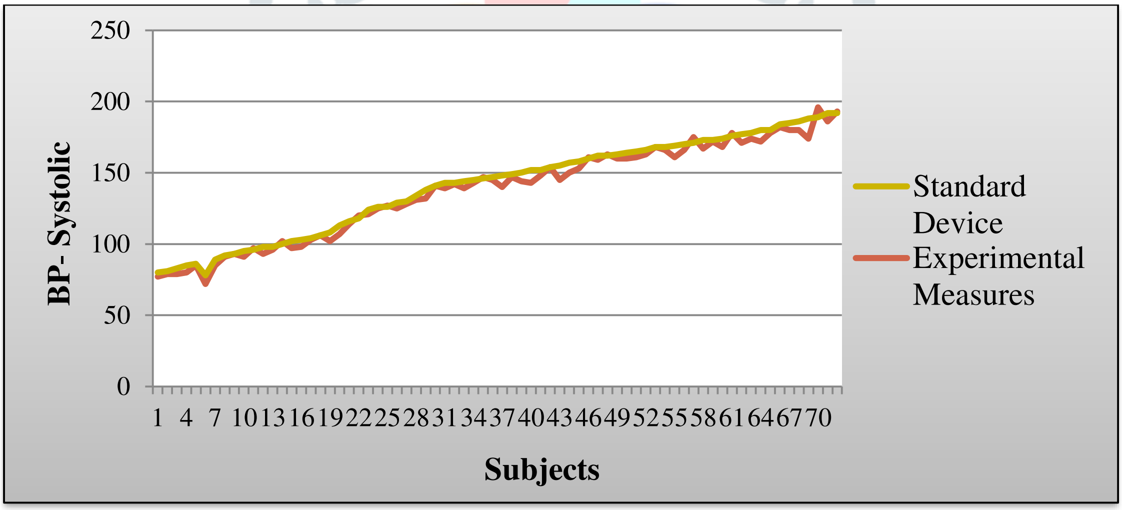

Fig 5.2 Plot Showing the Comparison of Data for BP - Systolic

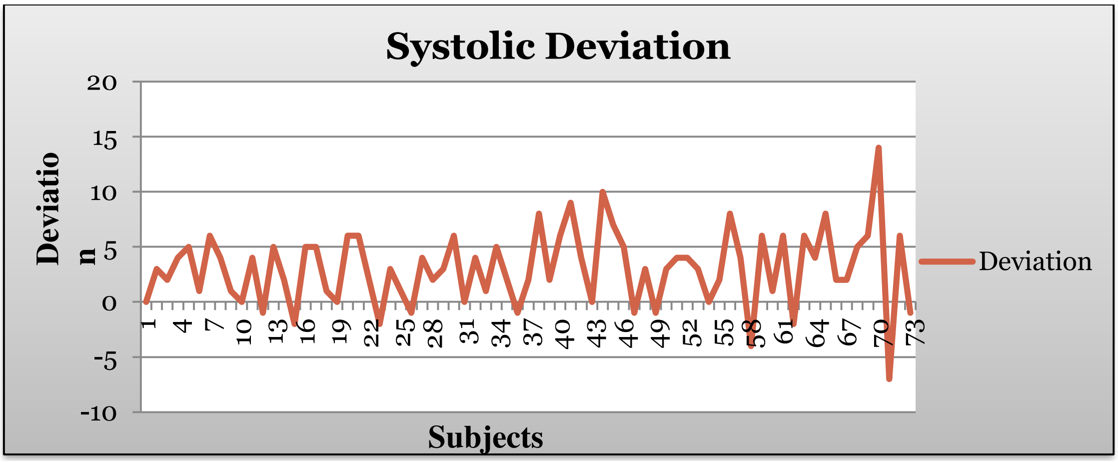

Fig 5.3 Plot Showing the Deviation for BP - Systolic

BP - Diastolic			
Sr No	Patients Data		Deviation
	Standard Device	Experimental Measures	
1	52	49	3
2	53	48	5
3	53	51	2
4	54	51	3
5	55	55	0
6	56	54	2
7	56	53	3
8	57	56	1
9	57	58	-1
10	57	53	4
11	58	56	2
12	59	58	1
13	60	62	-2
14	61	57	4
15	61	60	1
16	63	60	3
17	63	58	5
18	65	63	2
19	66	62	4
20	68	67	1
21	68	65	3
22	69	67	2
23	70	69	1
24	70	66	4
25	72	68	4
26	73	67	6
27	73	74	-1
28	74	71	3
29	76	75	1
30	78	74	4
31	82	79	3
32	82	82	0
33	83	78	5
34	84	87	-3
35	86	81	5

36	87	86	1
37	88	86	2
38	88	90	-2
39	89	83	6
40	90	86	4
41	92	89	3
42	93	91	3
43	93	94	-1
44	94	92	2
45	96	94	2
46	97	92	5
47	97	96	1
48	98	95	3
49	99	96	3
50	101	95	7
51	101	97	4
52	102	100	2
53	103	102	1
54	104	105	-1
55	106	99	7
56	106	106	0
57	107	102	5
58	108	105	3
59	108	100	8
60	110	107	3
61	112	108	4
62	112	111	1
63	114	115	-1
64	117	114	3
65	118	124	-6
66	120	118	2
67	121	121	0
68	122	116	6
69	122	118	4
70	124	121	3
71	126	126	0
72	126	128	-2

Table 3. BP - Diastolic Recorded by Different Means and the Deviation

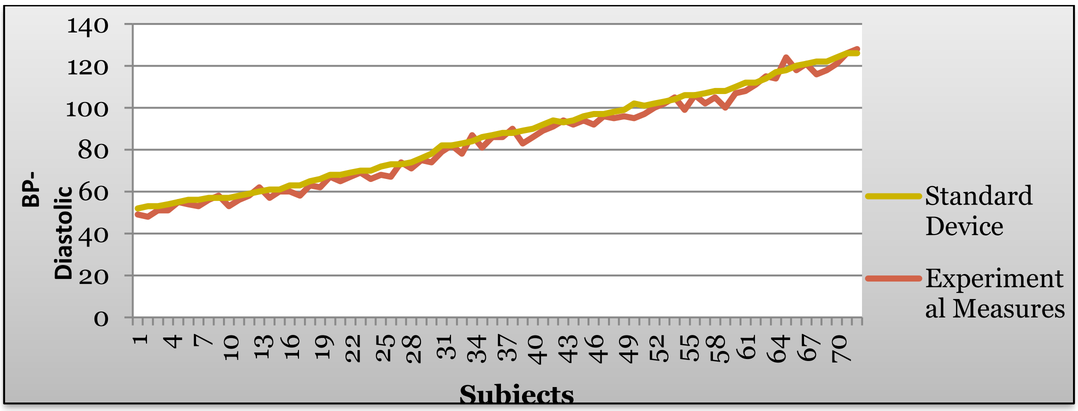

Fig 5.4 Plot Showing the BP for Various Patients

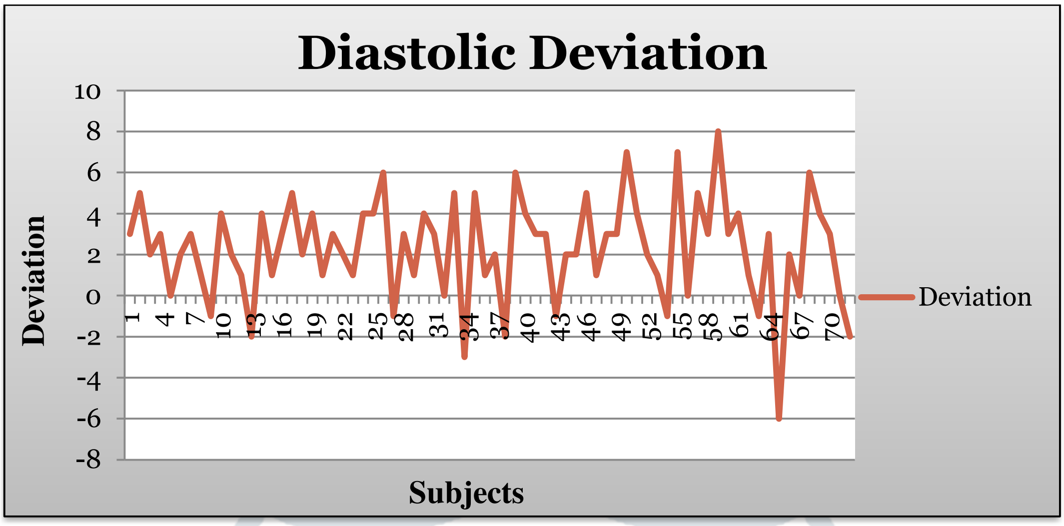

Fig 5.5 Plot Showing the Deviation for BP – Diastolic

The percentage of deviation for each subject was calculated. It was found that the percentage ranged between 0 and 8. Three different ranges were set between 0 and 8% – 0 to 2%, 3 to 5% and 6 to 8%.

VI. CONCLUSION

With this kind of approach and resource simple and very cost effective automatic blood pressure monitoring system using wireless technology can be designed which will be very useful in medical field, laboratories and industries where we can get better and more accurate result as compared to other biomedical devices.

VII. REFERENCES

1. Mahajan Khushal, Chaudhary Jaydip, Bachhav Jitendra, Prof. Ms. A. B. Pawar, "GSM Based Patient Health Monitoring System Using AVR",International Journal on Recent and Innovation Trends in Computing and Communication IJRITCC, Vol.4, Issue: 4, April 2016, ISSN: 2321-8169, pp 442 – 445.

2. Aliyu Ahmed, Ajao Lukman Adewale, Agajo James, Olaniy Olayemi Mikail, Buhari Ugbede Umar, Emmanuel Samuel, "Human Vital Physiological Parameters Monitoring: A Wireless Body Area Technology Based Internet of Things", Jurnal Teknologi dan Sistem Komputer,Vol. 6, Issue 3, 16 April 2018, e-ISSN: 2338-0403, pp 115-121.

3. www.smartech.sensors.com

4. Brandon Sbert, Ricardo Wheeler, Bianca Belmont, A. Raj Bose, "Blood Pressure Tester", Initial Project and Group Identification IEEL 4914 Senior Design I Fall 2011 Group, Texas Instruments, Workforce Florida, pp 1-137.

5. Ayala Kenneth J."The 8051 Microcontroller", Published By Penram International (India), Second Edition.

6. Dougherty Kelvin M.," Analog To Digital Conversion" A Practical Approach, Mc-Graw-Hill, Inc.

7. Hall D.V,"Microprocessor & Interfacing Programming Hardware", Tata Mc-Grow-Hill Edition, 1991, Seventh Reprint1995.

8. Mazidi Muhammad Ali, Mazidi Janice Gillispie,"The 8051 Microcontroller And Embedded Systems" Published By Pearson Education (Singapore) Pvt. Ltd, First Edition.

9. S.S.Shende, P.B.Dahikar2, MJ.Hedau3, K.Y. Rokde4 International Journal of Innovative Research in Computerand Communication Engineering(An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 1, January 2014 p-p 2626-2631

10. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Wireless Signal Simulation Via Cell-Phone "International Conference on circuit system and simulation, , pp. 92–95, Vol.7, IACSIT Press, Singapore, 2011

11. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Microcontroller in Technical communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588Vol.5Issue 1,2012.

12. K Y Rokde, P.B.Dahikar, S.S.Shende, S.M.Ghatole, M.J.Hedau "A Non-Invasive Blood pressure measurement using Embedded Technology"International Journal Scientific Research in Science and Technology, IJSRST, ISSN No 2395-6011 ,Vol.4 Issue 1, 2018.

13. K.Y.Rokde, P.B.Dahikar, N.P.Wakde, S.S.Shende, "Design and Implementation of Heartbeat and Pulse Oxymeter Monitoring system on General Intensive Care Unit" International Journal of EmergingTechnologies and Innovative research, JETIR, ISSN 2349-5162, vol.5, Issue 5, 2018.

14. K.Y.Rokde, Dr. P.B.Dahikar, Dr. M.J.Hedau, S.S.Shende, "An Embedded System for Device Control System with Telephone Answering Machine", International Journol of Researches in Social Sciences and Information Studies IJRSSIS, Vol. 2, Issue 3, ISBN No-2347-8268, September 2014.

15. Md. Shamsul Arefin, Tajrian Mollick," International Journal of Scientific & Engineering Research", ISSN 2229-5518, Volume 4, Issue3, March-2013, IJSER © 2013.

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Design and Implementation of Fuzzy Logic Technique for Aircraft Control System

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Abstract:-

This research paper is about a Design and Implementation of Fuzzy Logic technique for Aircraft control system. In this study we describe an aircraft control system and landing of an aircraft are considered. An aircraft control system is a totally non-linear system when the final approach and landing of an aircraft are considered. It involves maneuvering flight in an appropriate course to the airport and then along the optimum glide path trajectory to the runway. We know that this path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. These orthogonal radio beams are known as the localizer and the glide slope and are tramitted from the ends of the runway in order to provide the approaching aircraft with the correct trajectory for landing. The pilot executing such a landing must monitor cockpit instruments that display the position of the aircraft relative to the desired flight path and make appropriate corrections to the controls.

In this research work the fuzzy logic technique has been explained with reference to the real world problems. The problem of Aircraft control system for Fuzzy logic technique is solved using the MATLAB programming software. The Fuzzy Logic methods are used for solving the Aircraft control system problems are Fuzzy Sets, Fuzzy Relation, membership function, non-transitive method etc. This paper is totally based on software implementation of MATLAB.

Keywords: Membership function, fuzzy set, Non-transitive method, Aircraft control system, decision making, and uncertainty.

Introduction:

Fuzzy Logic:

The real world is complex , complexity arises from uncertainty in the form of ambiguity." as the complexity of the system increases , our ability to make precise and yet significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics." These are the words of the LOTFI ZADEH who introduced fuzzy logic in 1965. " The closer looks at a real world problem , the fuzzier becomes its solution", observed Dr. Zadeh who published his seminal work "FUZZY SETS" in the journal or information and control.

When there is imprecision (more uncertainty) and inadequate data the fuzzy logic technique is useful. Secondly, the cost of information increases with precision. But the cost of fuzzy information is far less than the perfect or imperfect information. Thus, there are two – fold advantages of the fuzzy logic technique: Understanding of complex systems becomes easier and analysis makes the system costs effective. He used the linguistic variable and further suggested that set membership function is the key to decision making when there is uncertainty.

The attention currently being paid to fuzzy logic is most likely the result of present popular consumer products such as washing machine, cameras, elevators, air conditioners, rice cookers, automobile, dishwashers etc. The nature of uncertainty in a problem is a very important point that engineers should ponder prior to their.

Fuzzificaion:

Fuzzification is the process of making a crisp quantity fuzzy. We do this by simply recognizing that many of the quantities that we consider to be crisp and deterministic are actually not deterministic at all. They carry considerable uncertainty. If the form of uncertainty happens to arise because of imprecision, ambiguity or vagueness then the variable is probably fuzzy and can be represented by a membership function.

In the real world such as, digital voltmeter generates crisp data, but these data are subject to experimental error. The below fig 1.1 shows one possible range of errors for a typical voltage reading and associated membership function that might represent Such imprecision.

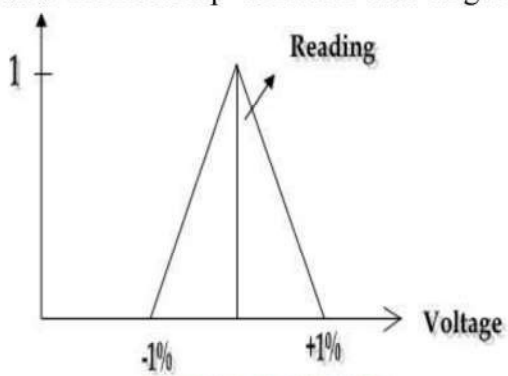

Fig 1.1 Membership function of crisp voltage reading

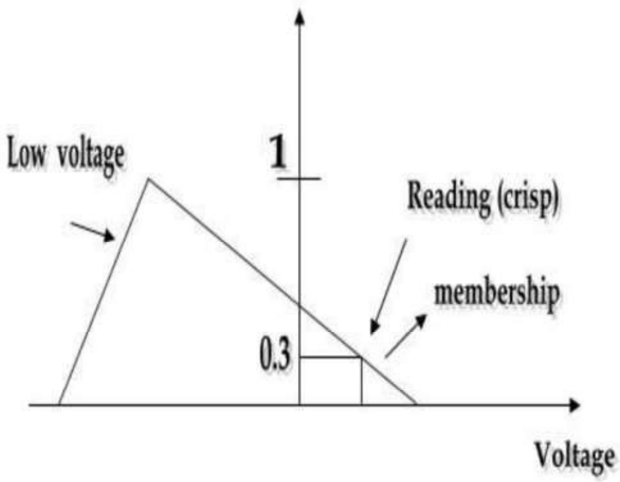

Fig.1.2 Fuzzy sets and crisp reading

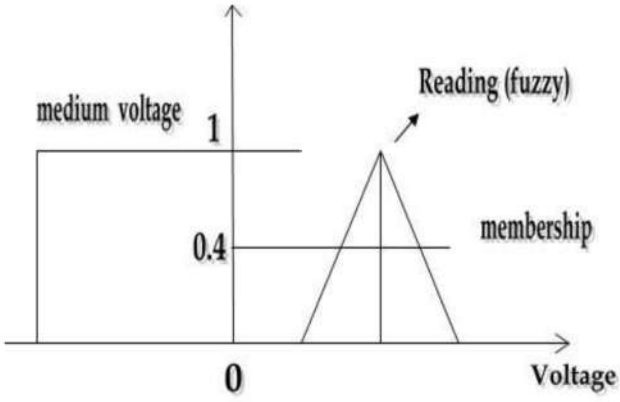

Fig. 1.3 Fuzzy set and fuzzy reading

Defuzzification:

It is the conversion of fuzzy quantity to a precise quantity. The output of a fuzzy process can be the logical union of two or more fuzzy membership functions defined on the universe of discourse of the output variable.

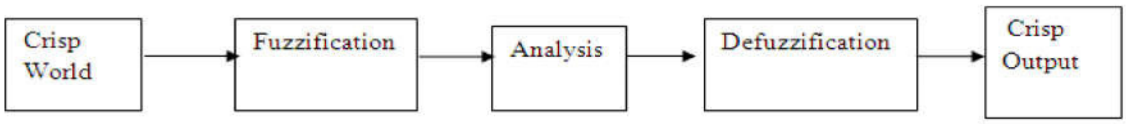

Fig (4) Block diagram of Fuzzy to Crisp Conversion

Aircraft Control System:

An aircraft control system is a totally non-linear system when the final approach and landing of an aircraft are considered. It involves maneuvering flight in an appropriate course to the airport and then along the optimum glide path trajectory to the runway. We know that this path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. These orthogonal radio beams are known as the localizer and the glide slope and are tramitted from the ends of the runway in order to provide the approaching aircraft with the correct trajectory for landing. The pilot executing such a landing must monitor cockpit instruments that display the position of the aircraft relative to the desired flight path and make appropriate corrections to the controls.

Methodology:

For solving the Aircraft control system problem using fuzzy logic technique number of methods are available like Fuzzy Sets, Fuzzy relation, Cartesian product, alpha- cut, Non-transitive ranking methods etc. Among this method we have selected the Non-transitive method for solving the power transistor problem.

Nontransitive Ranking Method

When we compare objects that are fuzzy, ambiguous, or vague, we may well encounter a situation where there is a contradiction in the classical notions of ordinal ranking and transitivity in the ranking. To accommodate this form of nontransitive ranking, we introduce a special notion of relativity.

Let x and y be variables defined on universe X. We define a pairwise function

$f_y(x)$ as the membership value of x with respect to y

And we define another pairwise function
$f_x(y)$ as the membership value of y with respect to x
then the relativity function is given by
$f(x/y) = f_y(x)/ \max[f_y(x),f_x(y)]$ (1)
is a measurement of the membership value of choosing x over y. The relativity function f(x/y) can be through of as the membership of preferring variable x over variable y.

To develop the genarl case for many variables, define variables x_1,x_2,------, x_i,x_{i+1}, ……,x_n. All defined on universe X, and let these variables be collected in a set A i.e $A= \{x_1,x_2,\ldots\ldots,x_{i-1},x_i, x_{i+1}, \ldots\ldots,x_n\}$. We then define a set identical to set a except this new set will be missing one element xi, and this set will be termed A'. The relativity function then becomes

$f(x_i/A')= f(x_i/ \{x_1,x_2,\ldots\ldots,x_{i-1},x_i, x_{i+1}, \ldots\ldots,x_n\})$

$= \min\{f(x_i/x_1), f(x_i/x_2),\ldots\ldots, f(x_i/x_i\text{-}1), f(x_i/x_{i+1}), \ldots\ldots,f(x_i/x_n)\}$……………(2)

Which is fuzzy measurement of choosing xi over all elements in the set A'. The expression in equ(2) involves the logical intersection of several variables; hence the minimum function is used. Since the relativity function of the variable with repsect to itself is identity.

$f(x_i/x_i)=1$ ………….(3)

then

$f(x_i/A')= f(x_i/A)$ …………..(4)

We can now form a matrix of relativity values. $f(x_i/x_j)$, where i,j=1,2,……..n, and where xi and xj are defined on a universe X. This matrix will be square and of order n, and will be termed the c matrix (c for comaprision). The c matrix can be use to rank many different fuzzy sets.

To determine the overall rnking, we need to find the smallest value in each of the rows of the C matrix; that is,

$C_i' = \min f(xi/X)$, i= 1,2,…….,n. (5)

Where Ci' is the membership ranking value for the ith variable.

Experimental Work

Presume that four positions are available to the pilot and that four corrections P1, P2, P3, and P4 from the actual position P are required to put the aircraft on the correct course. The pair wise comparisons for the four positions are as follows;

Fp1(P1)=1	Fp1(P2)=0.5	Fp1(P3)=0.6	Fp1(P4)=0.8
Fp2(P1)=0.3	Fp2(P2)=1	Fp2(P3)=0.4	Fp2(P4)=0.3
Fp3(P1)=0.6	Fp3(P2)=0.4	Fp3(P3)=1	Fp3(P4)=0.6
Fp4(P1)=0	Fp4(P2)=0.3	Fp4(P3)=0.6	Fp4(P4)=1

In this example, the non-transitive method is very useful.

Let x and y be two variables defined on universe X. We define a pair wise function fy(x) as the membership value of x with respect to y and we define another pair wise function fx(y) as the membership value of y with respect to x

Now, the relativity function given by

$f(x/y) = fy(x)/\max [fy(x),fx(y)]$ ……………..3.1

The relativity function f(x / y) can be thought as the membership of preferring variable x over variable y. To determine the overall ranking, we need to find the smallest value in each of the row of the matrix; that is,

C = min f(x/y) ………………3.2

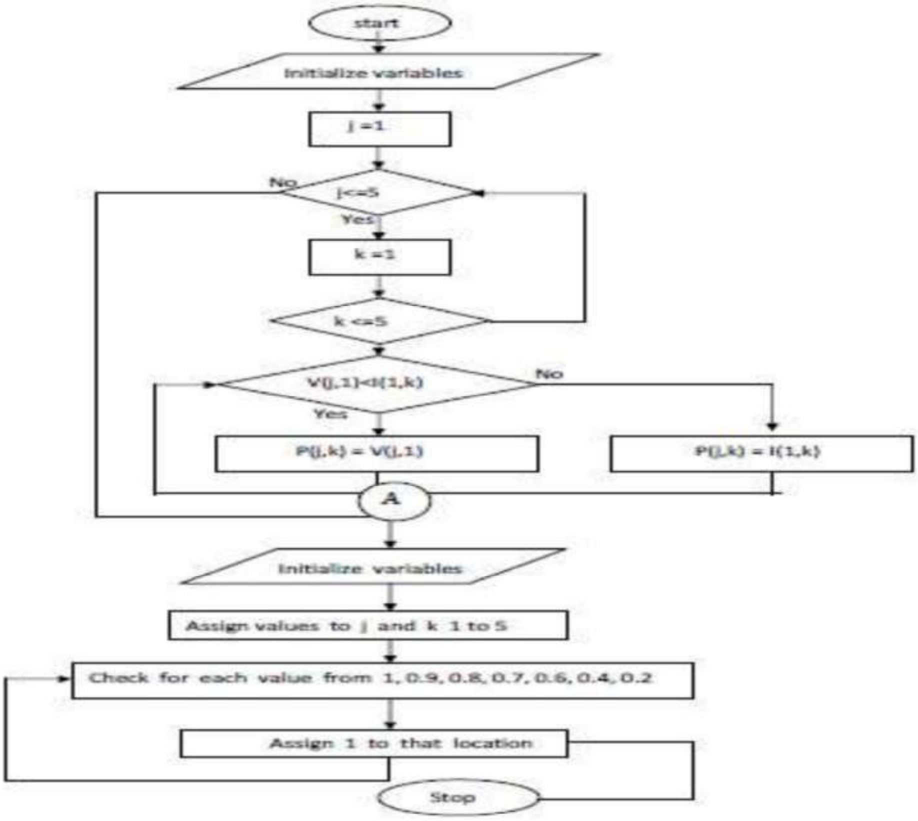

Fig: Flowchart for Aircraft control System

Programming in MATLAB:-

```
% program based on nontransitive method
% program for aircraft control system
% The pairwise comparisions for the four positions are as follows
% Fp1(p1)=1     Fp1(p2)=0.5    Fp1(p3)=0.6    Fp1(p4)=0.8
% Fp2(p1)=0.3   Fp2(p2)=1      Fp2(p3)=0.4    Fp2(p4)=0.3
% Fp3(p1)=0.6   Fp3(p2)=0.4    Fp3(p3)=1      Fp3(p4)=0.6
% Fp4(p1)=0     Fp4(p2)=0.3    Fp4(p3)=0.6    Fp4(p4)=1

P=[1 0.5 0.6 0.8;0.3 1 0.4 0.3;0.6 0.4 1 0.6;0 0.3 0.6 1]
F=zeros(4,4)
A=zeros(1,4)
for j=1:4
  for k=1:4
     F(k,j)=P(j,k)/max(P(j,k),P(k,j))        % formula of non-transitive ranking
  end
end
% Minimum of above function F in row wise and result stored in A
```

A(1,1)=min (F(1,j))
A(1,2)=min(F(2,j))
A(1,3)=min(F(3,j))
A(1,4)=min(F(4,j))

Result and Discussion

In the problem of Aircraft control system, the landing of an aircraft is considerd. The path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. In this problem, foue positions are avaialable to the pilot and those four corrections P1, P2, P3, and P4 from actual position P. The method is used in this problem is nontransitive ranking. The relativity function of nontransitive rnking is given by,

$f(x/y)= f_y(x)/max[f_y(x),f_x(y)]$

From this method we could solve the actual position of the aircraft.

This problem is solved using MATLAB programming and the result is displayed given below in matrix form.

Output:

P= 1.0000 0.5000 0.6000 0.8000
0.3000 1.0000 0.4000 0.3000
0.6000 0.4000 1.0000 0.6000
0.0000 0.3000 0.6000 1.0000

F= 0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0

A= 0 0 0 0
A= 0 1 0 0
A= 0 1 1 0
A= 0 1 1 1

Discussion

One area in which fuzzy set theory has a great potential that in psychology; in particular the psycho logistics which is essential for studying the connection between human communication and decision machines. Today, close to four decades after the artificial intelligence (AI) was born. It can finally be said that intelligent systems are becoming a reality. The soft computing has direct bearing on machine intelligence. Neuro fuzzy soft computing has a special role in the design of modern intelligent systems.

Applications Of Fuzzy Logic

- Control systems
- Pattern recognition
- Robotics
- Consumer electronics
- Automobiles
- Intelligent systems

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Fuzzy Logic In Consumer Goods

Cameras , Washing machine , Air conditioners , Luxury cars , Elevators , Rice cookers , Automobile , Dishwashers , Refrigerator , Camcorders , Vac. Cleaner etc.

Scope Of Work

The scope of further research work is to develop and design some electronic circuits such as speed control motor, automatic control system and some decision making problem like weather forecast. This has been recently used for user-oriented verification of probability forecasts, but there is applied to aid forecast users in optimizing their decision making from probability forecasts.

References

1. Ross T J , "Fuzzy logic with engineering applications" , MGH,(1997.
2. Klir G J , " Fuzzy sets , uncertainty, and information" , PHI, 2002.
3. J. E. Colgate and K. M. Lynch, "Mechanics and Control of Swimming: A Review," IEEE Journal of Oceanic Engineering, vol. 29, pp. 660-673, July 2004.
4. R. Ramamurti and W. C. Sandberg, "Computational Fluid Dynamics Study for Optimization of a Fin Design," In Proc. of the 24th AIAA , Applied Aerodynamics Conference, AIAA-2006- 3658, San Francisco, CA, 2006.
5. Lee C. C, "Fuzzy logic in control systems", IEEE Trans. On Systems, Man, and Cybernetics, SMC, Vol.20, No.2, 1990, pp. 404-35
6. Rudra Pratap, "MATLAB A quick Introduction for Scientist and Engineers", Oxford University Press 2004
7. Bernardinis L A, " Clear Thinking on Fuzzy Logic", Machine Design, April 23, 199.
8. Engineering(An ISO 3297: 2007 Certified Organization ,Vol. 2, Issue 1, January 2014 p-p 2626-2631
9. system and simulation, , IACSIT Press, Singapore, pp. 92–95, Vol.7., 2011
10. Cooper J A, "Fuzzy algebra uncertainty analysis for abnormal environment safety assessment", J intelligent and
11. fuzzy systems, January vol 3, issue 4, 337-346
12. Rokde K Y, Ghatole S M, Dahikar P B, Hedau M J, Shende S S, "Study of fuzzy logic technique for power
13. transistor problem" ,Interational Journal of Computer Engineering IOSR-JCE, pp 22-28.

DESIGN AND IMPLEMENTATION OF HEARTBEAT AND PULSE OXIMETER MONITORING SYSTEM ON GENERAL INTENSIVE CARE UNIT (ICU)

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Abstract : A novel approach which has potential to improve quality of patient care about Heart beat & pulse oximeter monitoring system on general Intensive Care unit is proposed. Patient care is a labour-intensive task that requires high input of human resources. A heart beat & pulse oximeter Monitoring system is proposed which can go some way towards improving patient monitoring on general Intensive Care unit. Sometimes it becomes necessary to monitor physiological events from a distance monitoring a patient in an ambulance and in other applications away from the hospital, collection of medical data from a home or office and use of telephone links for transmission of medical data. When the patient is in critical condition and is admitted in intensive care unit (ICU) or is being operated upon in the operation theatre (OT), it is crucial to monitor the patient for his physiological parameters such as heart beat, blood pressure, temperature, respiration rate, pulse oximeter rate etc. This monitoring is necessitated on account of the immediate response required for support of patients. The monitor provides the healthcare team with the information that is used to make decisions about the patient's treatment.

In this system vital signs i.e. signals are gathered from patients and sent to a control unit for centralized monitoring. The heart beat & pulse oxymeter monitoring system can complement the role of nurses in monitoring patients' vital signs. They will be able to focus on holistic needs of patients thereby providing better personal care. Wireless network technologies, ZigBee, Bluetooth, GSM and Wi-Fi, are utilized for transmission of vital signs in the proposed heart beat monitoring system. They provide flexibility and mobility to patients. The results illustrated the capability, suitability and limitation of the chosen technology.

Keywords: Embedded, Heartbeat, pulse oximeter, ICU, Remote patients Monitoring, Wireless etc.

I. Introduction

"Health is Wealth", is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research. Although many types of illnesses currently can be managed in an outpatient setting, there are clearly medical conditions that require more intensive care and treatment in a hospital. Generally, patients are either brought to an emergency or urgent care department for accurate diagnosis and management or a ICU to receive non-urgent treatment. The diverse healthcare environments generate different requirements of heart beat monitoring. These requirements should be carefully considered for further development in the healthcare system. In this paper the basic requirements of heart beat monitoring on general ICU will be studied.

II. HEARTBEAT MONITORING ON GENERAL INTENSIVE CARE UNIT (ICU)

A general ICU is a non-specialist hospital unit offering a range of treatments to a variety of patients. Advances in medical technology have led to patients living with much more complex health issues, leading to an increase in the variety of patients being managed within the ICU setting. Therefore, patients may require different level of care and attention; some require frequent visits by medical personnel whilst others who are in stable condition require less.

Heartbeat monitoring is an essential part of management and care of patients on Intensive care Unit (ICU). The purpose is to identify and record changes that occur to vital signs, as this may be helpful in preventing deteriorations of patients' condition. The frequency of monitoring may also vary depending on the severity of the patient's condition. Varshney (2006) suggested some basic requirements that should be considered in heartbeat monitoring on general intensive care unit (ICU). The following vital signs should be recorded at the initial assessment and as part of routine monitoring. Out of these vital signs, we have studied only Heart rate monitoring.

1. Heart rate
2. Oxygen saturation

3. Systolic blood pressure
4. Respiratory rate
5. Body temperature

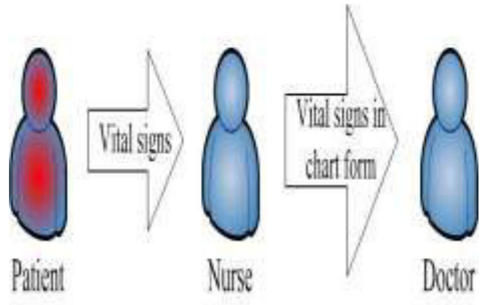

Figure 2.1 - Role of nurse in a Heartbeat Monitoring process

Vital sign measurement is the initial and the most important task in Heartbeat monitoring System. The existing instruments are commonly equipped with cable-based sensors, which make them bulky, intrusive and inconvenient. These sensors may not suit for long-term monitoring of vital sign in heartbeat monitoring on general intensive care unit(ICU). To improve comfort and mobility of patients, wireless biomedical sensors are considered. They are normally small in size and have wireless communication capability.

III. RELATED WORK

The functioning of this work is based on the fact that blood circulation occurs for every heart beat which can be sensed by using a circuit formed by the combination of an LDR and LED. Depending upon the rate of circulation of blood per second the heart beat rate per minute is calculated. This device consists of a microcontroller which takes the input from the heart beat sensor and calculates the heart rate of the patients.

A. SENSORS FOR HEART RATE MONITORING

Fig 3.1 Heart rate Sensor

Heart rate measurement indicates the soundness of the human cardiovascular system. The heartbeat sensor is based on the principle of photo phlethysmography. Heart rate is very important in patient monitoring. In traditional medicine, heart examination and monitoring was carried out by stethoscopes, through which medical personnel listened to a patient's heart sound and made decisions based on their knowledge and experience. The development of electronics and digital signals processing techniques have made it possible to use a small microphone to record cardiac sound and use a computer to analyze it. However noise cancellation is yet under research to ensure the accuracy of heart sound monitoring. 20 Budinger (2003) indicated that heart rate can also be measured by electrical waveform as well as pressure detection and electromagnetic flow. In this paper, some sensors that can be used to measure heart rate are evaluated; they are ECG, heart-rate chest strap and oximeter.

B. ELECTROCARDIOGRAPH (ECG) SENSOR

Figure 3.2 shows such a wireless 12-lead ECG. The hand-held device is for Wireless Transmission of ECG signals to a PC nearby or in remote location.

ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical events of a heart. It is used to indicate that the most prevalent ECG sensor involves the connection of 12 electrodes (also referred to as leads) to a patient's chest, arms and right leg via adhesive foam pads. The sensor records a short sampling (no more than thirty seconds) of the heart's electrical activity between different pairs of leads. Each pair of leads provides a unique and detailed picture of the cardiac rhythm by detect the change of electrical energy and referenced to a ground signal. It is indicated that computer-based applications and the development of wireless technology had allowed the transmission of 12-lead ECG waveforms from remote locations to a hand-held computer carried by a cardiologist.

C. HEART-RATE CHEST STRAP

Figure 3.3 - A heart-rate chest strap (adapted from (Techchee 2010))

Techchee (2010) stated that "current heart-rate chest strap is based on a tiny piezoelectric sensor to detect heart beat" (as shown in Figure 3.3). A microprocessor is integrated to transfer detected signal into heart rate. The heart rate is then sent by an integrated transmitter to a wrist-mounted device for display. The wrist-mounted device usually has local warning and wireless transmission capability. In the event that the wearer's heart rate goes beyond the threshold of a preset safe range, the wrist-mounted device will warn locally as well as sending an alert signal to a physician. In contrast to ECG sensors, the strap can be simply placed on a patient's chest for measuring heart rate without the assistance of skilled medical personnel. A heart-rate chest strap does not affect a patient's mobility; however the comfort needs consideration for long-term monitoring. Currently it is mainly used for patients with some degree of chronic disease who may require regular exercises and self-monitoring (Casio 2010).

D. PULSE OXIMETER

The pulse oximeter was invented for patient monitoring in the early 1970s (Tremper and Barker 1989). It can be used to examine two types of vital signs: heart rate and blood oxygen saturation. These parameters yield critical information, particularly in emergencies when sudden changes in the heart rate or reduction in blood oxygen saturation can indicate a need for urgent medical intervention. With advanced warning, patients could get treatments to avoid hypoxemia before they manifests physical symptoms (Shnayder *et al.* 2005).

Figure 3.4 - A wireless oximeter based monitoring system

A pulse oximeter typically incorporates a plastic housing, which contains an array of LEDs and an optoelectronic sensor opposite. By detecting the amount of light absorbed by haemoglobin in blood with two different wavelengths (typically 650nm and 805nm), the level of oxygen saturation can be measured. In addition, heart rate can be determined from the pattern of light absorption over time, since blood vessels contract and expand with the patient's pulse. Computation of heart rate and SpO2 from the light transmission waveforms can be performed using standard digital signal processing techniques. There are two types of oximeters, transmittance pulse oximeters and reflectance oximeters. The applied position of transmittance pulse oximeters is limited to the peripheral tissue, such as the fingertip, ear lobe, or toe.

IV. EXPERIMENTAL WORK

For designing and Implementation of an embedded system for heart beat & pulse oximeter monitoring of patients using wireless technology, the microcontrollers are to be selected. This system consists of a microcontroller which takes the input from the heart beat sensor and calculates the Heartbeat for the patients. Also same controller takes the input from the body signals and provides the pulse oximeter rate. The system design with Microcontroller, power supply, heart beat sensor, LCD, touch screen sensor, crystal oscillator, LED and LDR etc. In addition to this, some more resources required like RF transceiver modules, crystal oscillator etc. which will provide additional capability use for the complete system design.

The software aspect requires controlling & observing the Heartbeat of the patients. The controllers used in the research are programmed using Embedded C language and some assembly language programming.

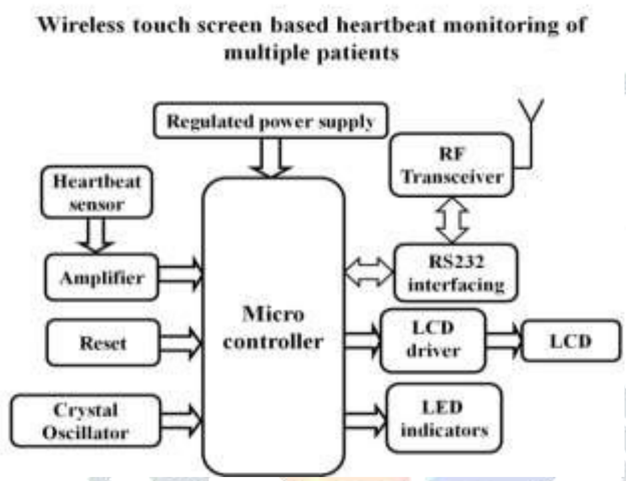

Fig 4.1 Block diagram of Heartbeat Monitoring of patients using wireless Technology

A. REGULATED POWER SUPPLY

Requirements of power supply is the main task, power supply of +5V and +12V is required for the circuit. The supply of +12 V needed for the relay connections and 7805 IC which has given +5V to the circuit.

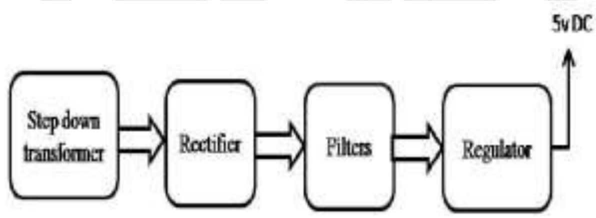

Fig 4.2 Power Supply

B. MICROCONTROLLER (PIC18F252)

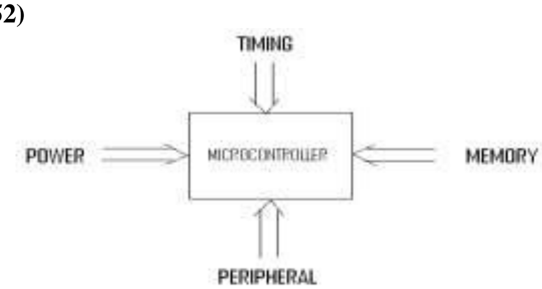

Fig 4.3 Essential block of microcontroller requirement

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. In this work PortA is used for the analog inputs, port B is used as output port for the LCD Display and on PortC there are 4 pins used for push-button and other 4 pins are used for the LED indication.

C. LCD (LIQUID CRISTAL DISPLAY) WITH DRIVER

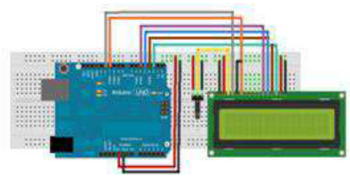

Fig 4.4 LCD (Liquid Crystal Display)

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light. Monochrome LCD images usually appear as blue or dark gray images on top of a grayish-white background. Color LCD displays use two basic techniques for producing color: Passive matrix is the less expensive of the two technologies.

D. RF TRANSCEIVER MODULES

Fig. 4.5 RF Module

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful heart beat monitoring of the patients.

E. GLCD WITH DRIVER

Fig 4.6. GLCD with Driver

The graphical LCD used in this experiment is based on KS0108B controller, which is a 128×64 pixel monochromatic display. The KS0108B is a dot matrix LCD segment driver with 64 channel output. On the other hand, the KS0107B is a 64-channel common driver which generates the timing signal to control the two KS0108B segment drivers. The KS0108B and KS0107B are a very popular controllers and have made their way into many graphical LCDs. The internal block diagram of the GLCD module is shown below.

H. LED INDICATORS

A Light-Emitting-Diode (LED) is a P-N junction device (diode) that gives off light radiation when biased in the forward direction. LED chip materials are combinations of elements from the III and V columns of the periodic chart. The light emitting phenomenon makes use of the recombination within the P-N junction instead of thermal radiation, therefore, LED's are free of waste and wear and can be expected to have a long life time. The photodiode and LED are used for the photoplethysmography unit. By controlling the forward current, the radiant flux of the LED can be easily controlled. The response time of an LED is very high (a few hundred nanoseconds) and can be pulsed at greater forward currents, to obtain high intensity radiant peaks. The resin packaging of LED's allow for superb mechanical integrity and can withstand dropping, vibration and shock. These semiconductor devices can be mounted in any position.

IV. CONCLUSION

An automated Heartbeat & pulse oximeter monitoring system by providing real-time monitoring could go some way towards improving patient care on general wards. Such a system gathers patients' vital signs and sends them to a control room for centralized monitoring. It can provide opportunity to improve the efficiency of patient monitoring and holistic care on general Intensive Care Unit (ICU). Sensors are important components in any Heartbeat monitoring system as well as pulse oximeter monitoring. Relevant sensors that can be used in Heartbeat were evaluated. The focus was on wireless sensors with the capability of measuring vital signs. A wireless sensor can offer enhanced mobility and comfort to patients during hospitalization. The capability and suitability of two wireless network technologies, Bluetooth and ZigBee were examined. Due to low-power consumption and security features, ZigBee-based wireless sensor networks were adopted. Two alternative approaches of using ZigBee-based sensor networks were discussed. They differed from the network topology deployed as well as the use of master nodes that control the communication progress within the network.

With this kind of approach and resource simple and very cost effective heart beat & pulse oximter monitoring patients using wireless technology on general Intensive Care Unit (ICU) can be designed which will be very useful in medical field, laboratories and industries where we can get better and more accurate result as compared to other devices.

V. FUTURE SCOPE

The Scope of research work intended to design and construct an Embedded System for heart beat & pulse oxymeter monitoring patients using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

VI. REFERENCES

1. Ayala Kenneth J."The 8051 Microcontroller", Published By Penram International (India), Second Edition.
2. Dougherty Kelvin M.," Analog To Digital Conversion" A Practical Approach, Mc-Graw Hill, Inc.
3. Hall D.V,"Microprocessor & Interfacing Programming Hardware", Tata Mc-Grow-Hill Edition, 1991, Seventh Reprint1995.
4. Mazidi Muhammad Ali, Mazidi Janice Gillispie,"The 8051 Microcontroller And Embedded Systems" Published By Pearson Education (Singapore) Pvt. Ltd, First Edition.
5. Khan, F. and Bilgainya, R., Synthesis and characterization of metal and metal oxide sponges using Triton X-165 as sacrificial template. Indian J. Chem. A, 2011, 55–59.
6. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Wireless Signal Simulation Via Cell-Phone "International Conference on circuit system and simulation, , pp. 92–95, Vol.7, IACSIT Press, Singapore, 2011
7. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Microcontroller in Technical communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588Vol.5Issue 1,2012.
8. P. B. Dahikar M. J. Hedau, S. C. Moholkar "Application of Microcontroller in Receiving Unit of the Technical Communication "International Journal of ETA and ETS, IACSIT ISSN No 0974-3588 Vol.5 Issue 2, 2012.
9. Md. Shamsul Arefin, Tajrian Mollick," International Journal of Scientific & Engineering Research", ISSN 2229-5518, Volume 4, Issue3, March-2013, IJSER © 2013.
10. Yuanlong Liu, "Wireless remote patients Monitoring on General Hospital Wards" Bournemouth University.

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A Non- Invasive Blood Pressure Measurement Using Embedded Technology

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ABSTRACT

A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment provides accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research. Sometimes it becomes necessary to monitor physiological events from a distance like monitoring a patient in an ambulance and in other applications away from the hospital, collection of medical data from a home or office and use of telephone links for transmission of medical data.

In this research work it is to study the Non- Invasive Blood Pressure Measurement of patients using embedded technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries. In present development, the real time blood pressure biomedical signal is measured using an optical measurement circuit based plethysmography technique(PPG) contineously for a long period of time.The detected measured signal amplified using an operational amplifier circuit and interface with the microcontroller. The numerical reading values of systolic and distolic blood pressure remotely recorded and displayed with the help of LCD and stationary computer.

Keywords: Blood Pressure, Wireless, Non-invasive, monitoring system etc.

I. INTRODUCTION

"Health is Wealth", is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research.

Blood Pressure:

Blood pressure is the most often measured and most intensively studied parameter in medical and physiological practice. Pressure measurements are a vital indication in the sucessful treatment and management of critically ill patients in an intensive cardiac care unit or the patients undergoing cardiac catheterisation.

The meaurement of BP are of great importance because it is used for detection of hypertension (high blood pressure). Hypertension is a continuous, consistent, and independent risk factor for developing cardiovascular disease. Hypotension can cause the blood supply to the brain, heart and other tissues to be too low, and hypertension is strongly correlated with higher risk for cerebral stroke and heart infarct. Blood pressure measurement is also important for particular disease patients, such as hemodialysis patients. Hence, in the daily life, blood pressure measurement and management is very useful for handling health situation and plays a preventive function.

II. METHODOLOGY

Photoplethysmography Unit (PPG):

Figure 1. Photoplethysmography Technique

pressure monitors are based on oscillometric method accepted and widely used mobility, they require suitable for home-care and long-term monitoring of BP for homecare inexpensive method that is and does not require These requirements can be which will be designed using technique. method used to measure volume in the tissues. It utilizes contains an infrared light a part of the tissue photo-detector receives the obtained from this technique which can be used to is shown in fig. 1 where used as the source and a phototransistor is used as the detector.

More to the point, a developed technique based on a noninvasive continuous blood pressure measurement using volume oscillometric method and photoplethysmograph technique has been investigated , and the study uses high intensity LED and a LDR (Light Dependent Resistor) and placed them at the edge of a finger. The concept is that the resistance of the LDR changes according to the light intensity received by the LDR. The change in resistance is proportional to the change of blood volume and as well as blood pressure in the finger. The result showed the systolic and diastolic blood pressure on a mini LCD. In addition, a non-invasive blood pressure monitor was developed using photoplethysmograph method.

III. EXPERIMENTAL WORK

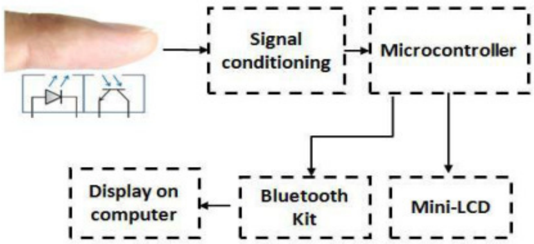

Figure 2. Circuit diagram of system.

A. Sensing Stage

The detection of the blood pressure signal is based on using optical measurement technique called photoelectric plethysmography (PPG). This technique has the ability to detect the volume of blood pressures in the arteries. The PPG basic form utilizes two components: a light source to illuminates a part of the tissue (e.g. fingertip) and a photo detector to receive the light. Transparency of living tissue to light makes it possible for some part of the light from the source to pass through the tissue to the photo-detector.

However, some part of the light is absorbed by the blood, bone, muscle and skin in the tissue. The volume of the blood in the vessel varies while the volume of other part remains constant. Therefore the light absorption is varied only by the change of volume of blood (increases or decreases) and the returning light to the photo-detector changes according to the change of blood volume. The electrical resistivity of the photo-detector changes depending on the amount of light falling on it. This change of resistivity results is the change of electrical current flowing in the detector which is converted into PPG signal.

Figure 3. Optical Sensor

B. Signal Conditioning Stage:

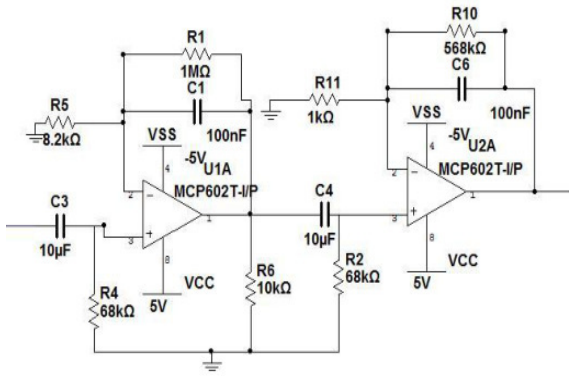

Figure 4. Circuit Diagram

After the sensor detected the changes in the volume of blood pressures, a low frequency and low magnitude biopotential signal is received by the photodiode. As the detected PPG signal is so weak, it must undergo some signal conditioning (e.g. amplifying and filtering) so that it can be used for further processing. Since the output voltage of the photo-detector has a large amount of dc component which requires a filter to suppress out the dc component. A good filter choice will be the use of an active bandpass filter because its first cut off frequency can be used to remove direct current (DC) and its second cutoff frequency can be used to remove unwanted high frequency components in the signal like power line interference (50 Hz). In addition, the filter is also used with a very high gain for amplifying the signal. Two stage bandpass filter are used and each stage has different gain.

C. Microcontroller Stage:

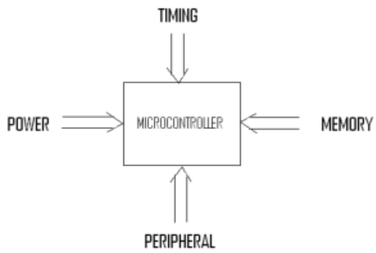

Figure 5. Essential block of microcontroller requirement (PIC18F252)

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. The output of the signal conditioning stage is fed into a microcontroller where it is processed (sampling and quantizing). The PIC18F252 microcontroller is used in this system where it has a built-in ADC. The PIC18F252 device family can operate at speeds up to 12MIPS and has a hardware multiplier for faster calculation of control algorithms. The microcontroller finds out the smallest (represents DBP) and the largest (represents SBP) value form the output voltage using a program written in MPLAB X IDE.

The microcontroller then displays the measured blood pressure information in mini LCD and transmits them through a Bluetooth device to any stationary enabled computer device. Buzzer alert of the system helps the patient itself to be aware of his/her condition and can take necessary steps towards medication. At the same time, physician can also diagnose the patient from a remote location as system provides SMS alert at critical situations. The Bluetooth interface provides a convenient and low power consumption method for data transmission. This system provides users an easy-to-interface interface and simple blood pressure management environment.

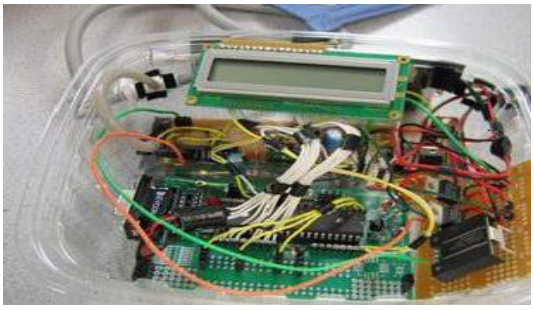

Figure 6. Experimental Work

D. LCD (Liquid Crystal Display) with Driver.

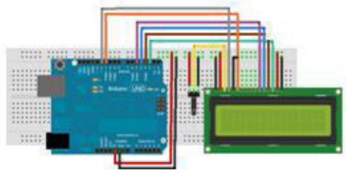

Figure 7 . LCD (Liquid Crystal Display)

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

E. Bluetooth Technology

By using Bluetooth (SKKCA-21) Remote Control. SKKCA-21 module offers simple yet compact Bluetooth platform for embedded applications. It has a surface mount layout which makes the process of development and application easier. The Bluetooth transmits the reading to the PC equipped with Bluetooth. The display on computer is acquired using special software called Parallax-Serial-Terminal. It is simple terminal software which allows users to display results through predefined serial ports.

F. RF Transceiver Module.

Figure 8. RF Module

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

IV. RESULT AND DISCUSSION

Age	**Gender**	**PPG(reading)**
20	Female	79
26	Female	78
38	Male	84
56	Male	65
60	Male	70

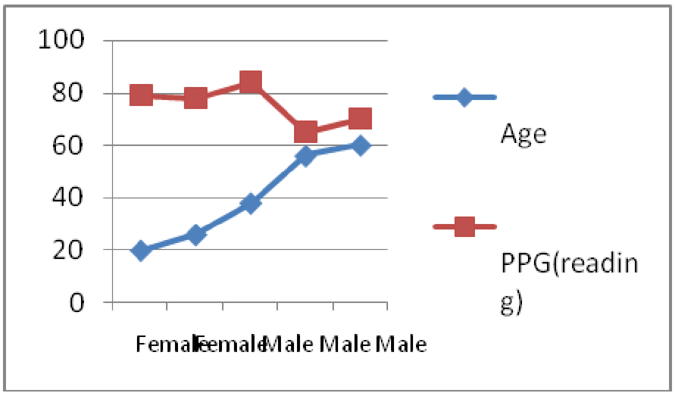

Figure 9. Graph in between Age, Gender and PPG readings.

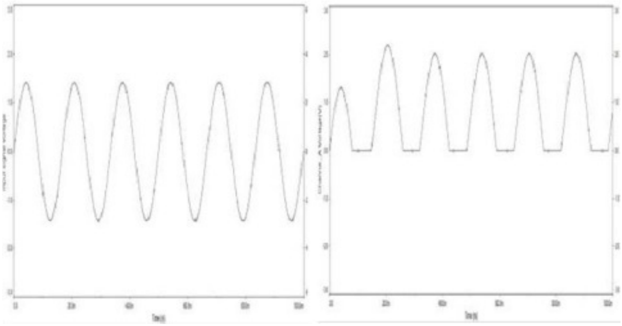

Figure 10. Input and output waveform of amplifier in Multisim

V. CONCLUSION

With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The small embedded system can display the systolic and diastolic blood pressure on a mini LCD as well stationary computer which is a Bluetooth enabled device though Bluetooth wireless technology. In case of any abnormal changes in the blood pressure readings, the system alerts using a buzzer and it also send a message to the predefined number(i.e. a physician number) using GSM. Furthermore, the obtained results will be compared with existing devices data like a sphygmomanometer to verify the accuracy of the developed instrument. This system provides users an easy-to-use interface and simple BP management environment. The Bluetooth interface provides a convenient and low-power consumption method for data transmission. This work may further be extended in future to include more number of physiological parameters like heart rate, oxygen saturation, respiration rate etc. to be monitored for a long period of time. GPS system can be used to spot the exact position of the patient and thus can provide immediate help if required.

VI. FUTURE SCOPE

The Scope of research work intended to design and construct an Non invasive blood pressure measurement using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

VII. REFERENCES

[1]. Ayala Kenneth J."The 8051 Microcontroller", Published By Penram International (India), Second we3

[2]. Dougherty Kelvin M.," Analog To Digital Conversion" A Practical Approach, Mc-Graw Hill, Inc.

[3]. Hall D.V,"Microprocessor & Interfacing Programming Hardware", Tata Mc-Grow-Hill Edition, 1991, Seventh Reprint1995.

[4]. Mazidi Muhammad Ali, Mazidi Janice Gillispie,"The 8051 Microcontroller And Embedded Systems" Published By Pearson Education (Singapore) Pvt. Ltd, First Edition

[5]. Gurnule W B,; Dhote S S,; Pharma J. Der Chemica,; 4(2): 791,2012

[6]. Khan, F. and Bilgainya, R., Synthesis and characterization of metal and metal oxide sponges using Triton X-165 as sacrificial template. Indian J. Chem. A, 2011, 55–59.

[7]. S.S.Shende, P.B.Dahikar2, MJ.Hedau3, K.Y. Rokde4 International Journal of Innovative Research in Computerand Communication Engineering(An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 1, January 2014 p-p 2626-2631

[8]. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Wireless Signal Simulation Via Cell-Phone "International Conference on circuit system and simulation, , pp. 92–95, Vol.7, IACSIT Press, Singapore, 2011

[9]. M. J. Hedau, M. P. Dhore, P. B. Dahikar, "Application of Microcontroller in Technical communication"International Journal of ETA and ETS, IACSIT ISSN No 0974- 3588Vol.5Issue 1,2012.

[10]. P. B. Dahikar M. J. Hedau, S. C. Moholkar "Application of Microcontroller in Receiving Unit of the Technical Communication"International Journal of ETA and ETS, IACSIT ISSN No 0974-3588 Vol.5 Issue 2, 2012.

[11]. K.Y.Rokde, Dr. P.B.Dahikar2, Dr. M.J.Hedau3, S.S.Shende 4 International Journal of Innovative Research in Computer and Communication Engineering(An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 9, September 2014 p-p 2320-9798.

[12]. K.Y.Rokde, Dr. P.B.Dahikar, Dr. M.J.Hedau, S.S.Shende, "An Embedded System for Device Control System with Telephone Answering Machine", International Journol of Researches in Social Sciences and Information Studies IJRSSIS, Vol. 2, Issue 3, ISBN No-2347-8268, September 2014.

[13]. Md. Shamsul Arefin, Tajrian Mollick," International Journal of Scientific & Engineering Research", ISSN 2229-5518, Volume 4, Issue3, March-2013, IJSER 2013.

[14]. Basem Abu Zneid1, Mohammed Al-zidi1, Tareq Al-kharazi," IEEE region 10 symposium,"april 2014,PP- 248-253, Kaula Lumpur, Malaysia.

[15]. Rokde K Y, Shende S. S, Ghatole S M, Dahikar P B, "International Journal of Electronics, Communication and soft computing science and Engineering- IJECSCSE", PP No-1-4, vol 1, issue 1, 2015.

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An Economical Non-Invasive Epidermis Thickness Measurement by the Application of Oct

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***Abstract* – The skin is the largest multifunctional organ in the body. It behaves as a protective physical barrier by absorbing UV radiation, preventing microorganism invasion and chemical penetration, and controlling the passage of water and electrolytes. There is always a need for developing a novel application for epidermal thickness estimation by non-invasive methods. Non-invasive methods such as Montecarlo method, Infrared diffuse reflection spectroscopy, Infrared light method, Pulsed Ultra Sound, Optical Coherence Tomography, Laser Scanning Microscopy are some of the widely used methods for epidermis thickness estimation. A cost effective non-invasive method to determine epidermal thickness from the intensity of light transmitted in visible region is proposed. Light is passed through the epidermis layers, and then measured what is transmitted back out of the surface. It is observed that transmittance is linearly dependent on the thickness of the epidermis and thus the method can be used for thickness estimation.**

***Keywords* – Epidermis Thickness, LSM, OCT.**

I. Introduction

Skin thickness determination is valuable for various applications. The thickness of skin tissue and the individual layers provide valuable diagnostic information in a number of circumstances. For example, skin thickness is an important indicator of changes in the skin due to chronological ageing and photo ageing. Skin thickness measurements also provide important information related to a variety of endocrine disorders.

Skin thickness is an important skin property in cosmetology, dermatology and pharmaceutical science. It varies significantly between the face and other body parts, and changes with age and environment factors. Changes that markedly affect aesthetics, such as wrinkles, sagging and skin elasticity are the result of physiological changes in the epidermis and dermis layers. Measuring the structural conditions of the epidermis and dermis has, until now, only been possible using complex methods and has required cumbersome equipment.

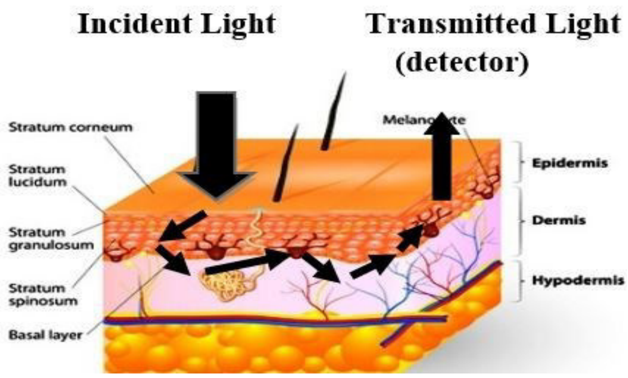

Fig. a. View of a multilayered structure of the epidermis, dermis and hypodermis, along with path of a single photon within the skin.

II. Invasive & Non-Invasive Thickness Measurement

Techniques that can be used to measure the thickness of the epidermis can be categorized in two groups

(a) Invasive:

In Invasive techniques thin cross-sections is obtained from biopsies and prepared using the conventional paraffin-formalin preservation method. This method, offers large amount of data about the sample, has less than 1 µm resolution in deep tissues. Unfortunately, during preparation of the tissue, it deforms and changes the thickness of the sample, due to this reason this method is not used for exact epidermal thickness measurements.

(b) Non-Invasive:

This technique employs two common methods as follows

(1) Laser Scanning Microscopy (LSM):

It is considered a high resolution technique with less than 1 µm resolution. It has the advantage that it produces very good quality horizontal images of the skin but the disadvantage is that a fluorescent agent must be injected to ensure a good image and to determine the exact thickness of the epidermis.

(2) Optical Coherence Tomography (OCT):

It has a typical resolution of 10–30 µm. It is used to obtain images at depths in the range of millimeters. Its advantage is that vertical or in-depth images are better captured but disadvantage is that contrasting agent must be applied.

The above two non-invasive can be efficiently used to determine skin thickness, but these techniques are expensive and difficult to implement. We propose an alternative to the above mentioned technique in the present study: a simple and economic technique, which is non-

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invasive and capable of determining epidermal thickness as a function of the measured transmittance in the visible region of the spectrum. The proposed method is based on the study made by Meglinski and Matcher in which the spatial distribution of detector sensitivity, inside a multilayer medium with strong scattering and absorption, is analyzed.

III. Experimental Setup

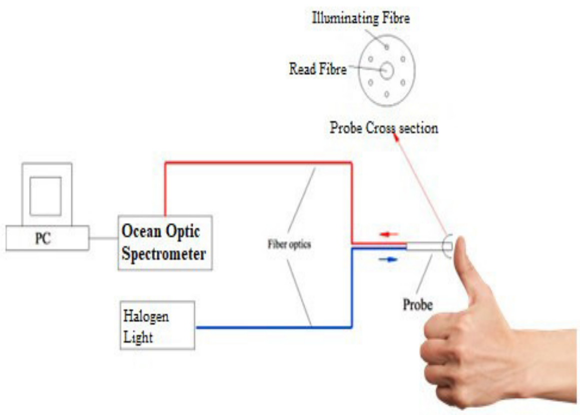

Fig. b. Experimental setup used to measure the transmitted light intensity

As shown in fig b. The experimental setup consists of a halogen light source, an Ocean Optics spectrometer and a reflectance fiber. The reflectance fiber has a central fiber and six outer fibers joined together. The central fiber is connected to the spectrometer and the outer fibers are connected to the light source, such that one collection fiber and six illumination fibers are available. The light emitted from the source travels across all of the outer fibers until it reaches the skin. A portion of the reflected beam is collected by the central fiber, which carries the beam to the spectrometer, from there it is given to ADC or Data acquisition System and then to PC for further store, analysis and processing.

IV. Procedure

The Experiment was carried on in each fingertip of the left hand of 10 persons.

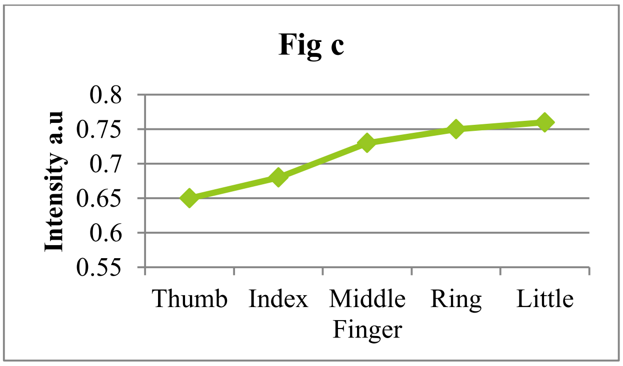

Fig c shows the Transmittance of five fingers in one of the sample.

In order to calibrate our measurements, we determined the thickness of the fingertips using OCT images and then related them to the transmittance intensity measured for each fingertip.

Once the images were acquired, it is identified the epidermal-dermal boundary by an imaginary line. For each image, ten data points (over the line mentioned above) were chosen to obtain the median epidermal thickness.

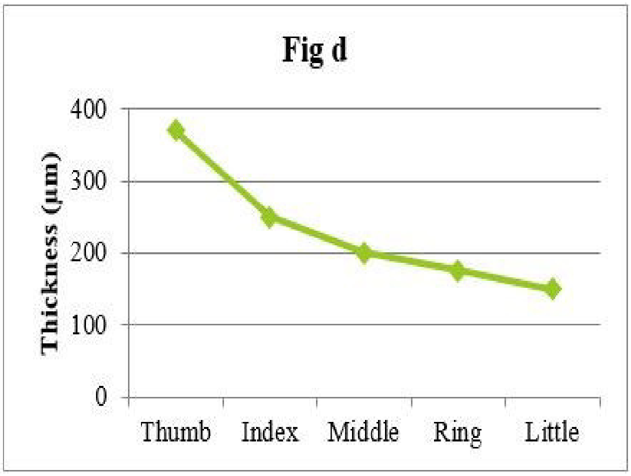

Fig. d. shows the epidermal thickness measurements for thumb, ring, median, index and little finger for one subject

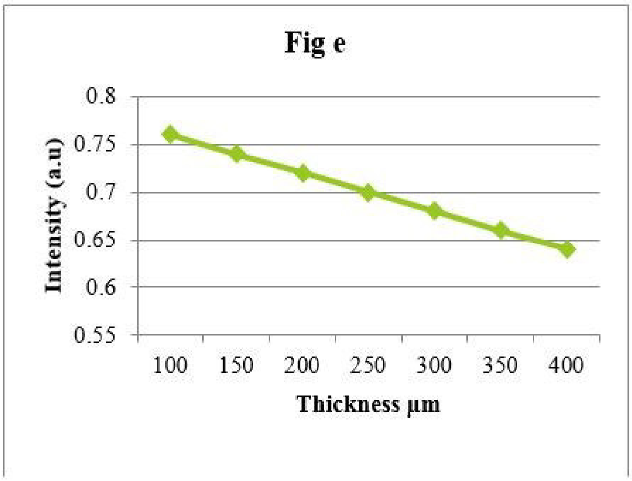

Fig. e. shows the mean intensity of the transmittance measured *in vivo*, as a function of the mean epidermal thickness (obtained by OCT images).

V. Discussion

Earlier different methods such as cross sections cuts, OCT and LSM were used to determine epidermis thickness. Each of these techniques has certain property that makes it suitable for specific applications. The proposed method demonstrates that a noninvasive technique, using transmittance can be used to determine epidermal thickness

From the above procedure thumb has the greatest epidermal thickness and little finger has the least. The technique can be used as a simple, economic and non-invasive method to measure epidermal thickness.

VI. Conclusion

The technique proposed can effectively measure thickness of the epidermis, by a simple noninvasive transmittance measurement. The technique depends on OCT to compare the thickness to the measured transmittance. After the calibration is done we can measure the thickness of epidermis. Though this technique is not very accurate but it is very cheap method to determine thickness of the epidermis.

References

[1] Adrian Peña, Miguel Arronte, Eduardo De Posada, Luis Ponce and Teresa Flores, 2014. Non-Invasive optical method for epidermal thickness estimation. ISSN: 1608-4217 ©2014 Science Publication doi:10.3844/ojbsci.2014.163.166 Published Online 14 (2) 2014 (http://www.thescipub.com/ojbs.toc)

[2] Alaluf, S., D. Atkins, K. Barrett, M. Blount and N. Carter *et al*., 2002. Ethnic variation in melanin content and composition in photo exposed and photo protected human skin. Pigment Cell Res., 15: 112- 118. DOI: 10.1034/j.1600-0749.2002.1o071.x

[3] Fruhstorfer, H., U. Abel, C.D. Garthe and A. Knüttel, 2000. Thickness of the stratum corneum of the volar fingertips. Clin. Anatomy, 13: 429-433. DOI: 10.1002/1098-2353(2000)13:6<429AIDCA6>3.0.CO, 2-5

[4] Huntley, A.C., 1989. Cutaneous manifestations of diabetes mellitus. Dermatol. Clin., 33: 605-617. DOI: 10.1111/j.1365-4362.1994.tb02915.x

[5] Lademann, J., N. Otberg, H. Richter, L. Meyer and H. Audring *et al*., 2007. Application of optical noninvasive methods in skin physiology: A comparison of laser scanning microscopy and optical coherent tomography with histological analysis. Skin Res. Technol., 13. DOI: 10.1111/j.1600- 0846.2007.00208.x

[6] Miyamae, Y., M. Kawabata, Y. Yamakawa, J. Tsuchiya and Y. Ozaki, 2012. Non-invasive estimation of skin thickness by near infrared diffuse reflection spectroscopy-separate determination of epidermis and dermis thickness. J. Near Infrared Spectroscopy, 20: 617-622. DOI: 10.1255/jnirs.1024

[7] Meglinski, I.V. and S.D. Matcher, 2001. Analysis of the spatial distribution of detector sensitivity in a multilayer randomly inhomogeneous medium with strong light scattering and absorption by the Monte Carlo method. Opt. Spectroscopy, 91: 654-659. DOI: 10.1134/1.1412689

[8] Meurer, M., M. Stumvoll and R.M. Szeimies, 2004. Skin changes in diabetes mellitus. Hautarzt, 55: 428-35. PMID: 15083279

[9] Zonios, G., A. Dimou, I. Bassukas, D. Galaris and Tsolakidis *et al*., 2008. Melanin absorption spectroscopy: New method for noninvasive skin investigation and melanoma detection. J. Bio. Opt., 13: 1-1. DOI: 10.1117/1.2844710

[10] S.S. Shende, PB Dahikar, MJ Hedau, KY Rokde, "An Alternative Technique to Perform Surgeriesin Hospital by Surgical Diathermy", "International Journal of Innovative Research in Computer and Communication Engineering" ISSN(Online): 2320-9801 ISSN (Print): 2320-9798, Vol. 2, Issue 1, January 2014

[11] S. S. Shende, M. J. Hedau, "Study of technique of detecting soft tissue", "International Journal of Researches in Biosciences, Agriculture and Technology (IJRBAT), ISSN 2347-517X, Vol II, Issue (7), Nov 2015:131-134.

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