Chapter – 2

Literature Survey and Scope of Research

2.1 Introduction
This chapter gives idea about existing decision support systems in medical science and prior work done in the area of digital image processing for medical science domain. Moreover, the chapter also focuses on the concepts of palmistry and medical palmistry in detail. It also discusses scientific theories and researches done in this field, which proves biological connection between brain, palm, and other organs of human body. Moreover it also discusses the existing system regarding to palmistry. At the end of this chapter, scope of research in this area is discussed.

2.2 Literature Survey
2.2.1 Decision Support Systems in Medical Science
Medical practice is interwoven with decisions. Physicians possibly make more decisions in their daily routine than those in any other profession. Physicians must first identify a disorder (diagnostic decisions), and then predict a certain course of pathophysiological behavior. Next, they must apply certain therapies based on the implied identity between the problem of a given patient and that of other patients who share similar symptoms and signs or who share the same diagnosis. These decisions may be subdivided into decisions regarding the best strategy of testing to differentiate among the different etiologies and diseases that may present similar manifestations. A decision must then unexpectedly be made as to when to stop gathering further information and start treatment. Next, there are decisions on the course of therapy, based on the current pathophysiological state and on the diagnosis of the disease, which, in turn, determines the prognosis of the patient.

There may be two independent inputs to the decisions on treatment: first the current pathophysiological state which presents a concrete clinical problem that requires intervention, and diagnosis is essentially a projection. Finally, decisions are made on the mode of follow-up treatment and on contingencies in case the treatment produces unexpectedly undesirable results.

The computer can be of assistance in making all of these decisions in several ways. It can provide facts stored in computer databases, it can use some of these facts to calculate various derived parameters, and it can use medical knowledge, to provide answers to more difficult questions that cannot be solved using the two former simpler methods. It can also become an autonomous machine which coverts its decisions into actions without human
intervention [5]. Let us understand these four levels on which computer can assist physician in the activity of decision making.

(i) The computer can provide factual information about the epidemiology of a given disease, about symptoms and signs associated with this and related diseases, about the efficacy of different diagnostic tests that might be used in this case, about the optimal test strategy for the clinical situation, about the availability of drugs that may be applicable to this case (on their efficacy and side effects as well as their interaction with other drugs), and about the outcomes of alternative therapies for a given disorder. It can also provide the names of physicians who have researched this disease or who are most experienced in administering given therapy. To achieve this kind of assistance essentially involves the straightforward use of computer database instead of library archives [5]. Regenstrief is one example of a computerized medical records system. With extensive records on more than 80000 patients dating back to the mid 1970s, experts say that the Regenstrief system is the largest known collection of computerized information on general medical patients [6]. Since last decade, most of the physicians keep the records of their patients in database, which may be helpful to them for future decision making.

(ii) The next level of computer assistance is the manipulation of the information of an individual case into a form that makes a decision much easier. Methods of data compression, feature extraction, and pattern recognition – all of these methods are designed to preprocess clinical input into a distinctive from which is easier to comprehend and act upon. Similarly the computer may use prescribed models to handle epidemiological data, to calculate doses of drugs as function of the anatomical and physiological features of a given patient, and to estimate the reliability of certain tests or treatments when applied to this individual case [5]. CT, MRI, PET are the best suitable examples of this level. These techniques are briefly discussed in section 2.2.2.

(iii) The third level of computer assistance involves the computer as a decision making machine. The physician is provided with the computer’s decision. For example, “This patient has disorder X”, “this patient should be given treatment Y”, or “To make a reliable recommendation about this case you must perform test Z”. The physician still has the option of taking the computer’s advice or leaving it. Before making a final decision to accept or reject the computer’s
assistance, he may also, in some case, question the computer and find out on which basis of facts and assumptions it reached its recommendation [5]. There are some expert systems in the world which ask questions to users and provide consultation to patients. On such system, INTERNIST – I, is discussed in following case study. The following case study includes selected content from full discussion given in the book “Computers in Medicine”.

INTERNIST-I is developed in a collaborative effort between the Universities of Pittsburgh and Stanford. INTERNIST – I uses a diagnostic knowledge base of about 550 diseases and syndromes in internal medicine and about 4000 manifestations (history facts, symptoms, and signs). Each of the disease is associated with 20 to 200 manifestations. The diseases may be linked associatively with other disorders by the causal links, predisposition (generic or environmental), coincidental inks (where the causality is not understood), and organ-system related links (e.g. detecting an infection in one organ may be linked to the same infection in another organ or to a systemic infection.

In performing a differential diagnosis the program puts weighting factors (1 to 5) on the frequency of occurrence of a given manifestation in a particular disease and on the prevalence of diseases with a given manifestation. The program keeps on asking the user for additional information that it needs to reach a satisfactory conclusion.

What has been tried here is to emulate the behavior of the consultant expert by programming the inputs of expert internists related to different diagnostic problems in internal medicine. This may often boil down to apparently intuitive responses, based, however, on many years of experience rather than on a depository of statistical data. A computer cannot think heuristically, but it can contain information generated by experts in a heuristic fashion.

The main advantage of the system is that, it is interactive. It keeps asking questions from the user until it reaches a satisfactory conclusion. You provide the computer with a small set of symptoms and signs you gathered from the history and physical exam, and the computer responds by asking for the next symptom or sign it expects from patient. By doing so, the computer assists you in your reasoning and reminds you of facts you may have forgotten or have never learned.
The limitation of this unique system (the only medical expert system with such a wide scope) include the necessity to communicate with the program with a rather arbitrary restrictive medical vocabulary, the arbitrariness of the knowledge base produced by a group dominated essentially by a single expert (Dr. Jack Meyers of Pittsburgh), the inability to find out readily the reasoning of the program in case the user disagrees with its recommended differential diagnosis.

Another limitation of INTERNIST-I is that it is being run exclusively on a computer at Stanford, thus it is accessible to most users, including the researchers in Pittsburgh, only through a slow and sometimes noisy phone link. Thus, in spite of its impressive history which culminates a 20 years long effort of Dr. Meyers and his group, this ambitious program is still far from being ready and available for routine use.

One of the major problems with this and other similar interactive programs is in the communication between the user and the computer. Responses of the computer may be explicit and unambiguous, but there is no way to control the user’s input to the same degree. One must require the use of a strictly coded dictionary of terms and relationships to avoid ambiguities, and this imposes on the user a non-natural language environment and significantly reduces the acceptance of computer assisted decision making. The alternative is to program the computer to understand natural language.

One more problem with INTERNIST-I is, it can handle only once disease at a time.

A much less sophisticated program is commercially available, called “Internist” (Coincidentally, the names are same), that matches the set of symptoms and signs provided to it with the symptoms and signs associated with a few hundred diseases, and comes up with a list of tentative diagnoses based on the number of correct matches between the input and the stored information.

Apart INTERNIST-I and Interist, there are some computer programs for well defined domain of expertise and goals. They are explained briefly as follows. CADUCEUS is successor of INTERNIST-I, which promises to encompass diagnostic problems in all of internal medicine. ONCOCIN only deals with treatment regimens of certain common types of cancer. ATTENDING critiques
methods and procedures in anesthesia. TIA offers consultation on the management of transient ischemic attacks in the brain. All these programs have their own scope and limitations.

(iv) The fourth and highest level of involvement of the computer allows it to take action based on its decisions. In this case, the only decisions left to the physician are whether to use the computer in this manner, and whether to change the decision algorithms of the computer which determine the course and the nature of its actions that are designed to meet the specific needs of the patient [5]. Usage of robots in medical science is the best known example of this case.

After observing above cases, one can conclude that, any practical expert system that might be adopted by medical community for routine use must meet the following requirements [5]:

(i) Provide rapidly unambiguous responses to queries regarding complex clinical situations, because straight-forward situations do not necessitate computer assistance, except learning settings).

(ii) Accept input in a variety of formats and linguistic expressions.

(iii) Have a well defined domain of expertise and goals.

(iv) Be comprehensive and self consistent. This criterion is difficult to meet. Since the inclusion of knowledge in the knowledge base is subjectively done by the designers of the system, any computerized expert system can be only as good as the experts who created it.

(v) Provide, on demand, an explanation for the computer’s response to a given query.

(vi) Have the intrinsic capability to “learn”. Any static expert system is doomed in face of the rapidly changing medical knowledge.

(vii) Be transferable. That is from mainframe to tablet computers; the system should be transferable to different device.

2.2.2 Image Processing in Medical Science

Image processing is perhaps the most important aid to medical practitioners in decision making. Beginning from X-rays, now a day CT, MRI, PET, SPECT, and ultrasound
velocity and absorption topographies have made the job of disease identification easier. 
All these imaging techniques can be classified based on three general categories [5]:

(i) Acquisition of the primary data
(ii) Data processing, including image reconstruction
(iii) Display and storage of the processed image

All the above mentioned techniques are discussed briefly as follows:

(i) CT (Computed Tomography): The primary feature distinguishing it from conventional X-ray radiography is its ability to form an image of a single cross-sectional slice of the body; tomography derives from the Greek word for a cutting or sectioning. Conventional X-rays on the other hand, form a two-dimensional image from a three-dimensional object by the superposition of the shadows arising from the full thickness of the examined object- in our case human body.

In order to obtain a sufficiently large number of independent attenuation values, as needed to reconstruct the image, measurements must be made at a large number of different angles through the slice, requiring in turn that the x-ray source and detector assembly is free to rotate entirely around the periphery of the section being imaged. Thus, if only for mechanical reasons alone, the orientation of the slice must be nearly transverse to the long axis of the body [5].

(ii) MRI (Magnetic Resonance Imaging): MRI is a completely new diagnostic modality based upon the magnetic resonance properties of atomic nuclei (NMR). It generates an image depicting the distribution of physical parameters whose diagnostic significance is yet to be fully established. MRI generates a signal which is a composite of three independent physical parameters: the density $\rho$ of resonating nuclei and two characteristic relaxation times denoted $T_1$ and $T_2$. The origin of the relaxation times in the physical processes underlying NMR will become clear later on; the density parameter is simply the number of resonating nuclei per unit volume in the imaged tissue. By collecting image data under a least three different sets of experimental conditions, the three properties can be separated out from the composite data by a straightforward mathematical procedure [5].
PET (Positron Emission Tomography): PET is based upon the radiation emitted by a particular class of radioisotopes, the positron emitters. A compound containing an isotope of this type is administered to the patient and its distribution through the body can be subsequently imaged by the PET technique [5].

SPECT (Single Photon Emission Computed Tomography): SPECT is an imaging modality based upon the detection of single photons generated by the decay of $\gamma$-emitting isotopes. As in the case of PET, the clinical significance of the resultant image reflects the properties of the molecular structure bearing the radioisotope, which in turn determines its distribution within the body. The “gamma camera” is most frequently utilized as the detector for SPECT [5].

Computed Ultrasound Images: in the most familiar methods of ultrasonography, the reflection of propagated sound waves from discontinuities or sharp gradients in acoustic impedance of the tissue forms the basis of the imaging technique. Much as in radar ranging, information concerning the location of the reflecting object in the plane of the scan is directly available from the time interval required for the return of the echo, and the direction of the probing beam. Little computation is necessary in generation an echo sonographic image [5].

As science and technology progress, new techniques are implemented to assist the medical practitioners in decision making. All such techniques are difficult to cover in this document. Therefore five most popular techniques are mentioned here. The major benefits of image processing in the field of medical science are as below [5]:

(i) With the image data set in memory, the computer can undertake the task of translating this information into a two dimensional display of the distribution through the body of the physical property being pictured.

(ii) Computers can display the image data in a form readily interpretable by the diagnostician, which is a common function to all of the specific imaging techniques mentioned above.

(iii) The image information is electronically stored in computer memory. Once the data is acquired from the patient, it can be used to generate a virtually limitless number of images with different parameter setting, all with no further involvement of the patient.
2.2.3 Limitations of Existing Image Processing Systems in Medical Science

The existing systems are different based on their motive and technology. So it is difficult to compare them with one another. Each technology has its own pros and cons, logically and technically. The limitations of systems, mentioned in section 2.2.2, in context of research work are as follows.

(i) These systems identify diseases after they materialized. They cannot give any idea about probable disease.

(ii) Expensive, because they use complicated equipments.

(iii) Time consuming

(iv) Require skilled operators to operate machines.

(v) The ultimate decision is taken by human being. That is analysis of image is manual process.

2.2.4 Palmistry

2.2.4.1 Defence

Brief introduction to palmistry is covered in chapter 1. Here, the general belief about palmistry and its validation is discussed. The discussion given below is by a well known palmist of last century, named “Cheiro”, from Europe, in his well known book – “The Language of Hand” [10].

“We will now see what science has done for palmistry, and whether or not it has any foundation beyond that of mere speculation and hypothesis. In this age of specialism which is so characteristic of the present century, we find in almost all departments of life, men devoting their time to some one particular branch of study. In past ages it was common for a man to be a physician, a chemist and a surgeon combined. There was, in fact, no limit to the things to which he might turn his attention. In the nineteenth century, however, and particularly towards its close, we found specialists arising in all directions. A surgeon need not practise as a physician, nor a physician as a surgeon; a dentist need not
be a doctor, and a chemist need not be a bone-setter. Particularly in science is this change seen, and with very astonishing results in the independent discoveries and improvements that have been made.

This specialisation has, however, one very great evil. It may give greater knowledge on particular things, but it confines men to a narrower line of thought. It therefore happens that the physician may know little about anatomy, whereas the surgeon may know next to nothing of medicine; the nerve specialist won’t treat the common ailments of life, and the doctor will not infringe upon the latter; the physician who devotes his talents to consumption cures won’t treat fever patients; and so on. Now all this leads up to a very grave point, namely, the unreasonable way in which the ordinary populace treat the ordinary medical man. A man sees, perhaps, a strange experiment in hypnotism; he goes to his physician, and because that physician, who probably has never devoted five minutes’ study to such a subject, pronounces such a thing impossible, the patient goes away and tells his acquaintance to pooh-pooh the idea, because, Dr. so-and-so does not believe in it. Now, when one considers that even in medicine there are hundreds of mysteries perfectly unknown to the ordinary medical man, how much more so may it not be in regard to the mysteries of life and nature, which are subject to invisible laws beyond the power of man to analyse?

Not more than twenty years ago almost every physician of note cried out that hypnotism was impossible. Today the same profession embraces it, and studies the very laws whose existence it once denied. It is the same with cheiromancy: for years they have pooh-poohed the idea; today they admit that diseases are indicated in a marvellous manner by the hand, and at present the study of the shape of the nails is a branch calling forth the greatest attention from medical men in both London and Paris”.[10].

Conclusion of this discussion is that, one should have expertise to explain or justify a particular field of science. A person who has no knowledge about particular field of science should not comment or justify the truth behind that science.

The researches done in the field of medical science have drawn out so many interesting results regarding to the validity of the concepts of palmistry. Conclusions of such researches are explained in section 2.2.4.2.

2.2.4.2 Scientific Study in the Field of Palmistry

Each concept should have scientific base to be considered as a fact. This section focuses the cases regarding to scientific base of palmistry. Many scientists, medical practitioners,
and professors have done research on the scientific side of palmistry. Their work is surveyed and conclusions are discussed here.

First let us observe some facts regarding to the relation between brain and palm [10].

1. The hand is a high stage of development peculiar to man as a reasonable being [10].
2. Tendencies, such as eloquence, anger, and affection, are shown by movements [10].
3. These movements are coarse and fine, and so produce large and small creases or lines [10].
4. Creases and lines, therefore, bear a definite relation to movements, and so to tendencies [10].
5. There are four well-marked creases or lines on every hand, found by experience to bear a definite relation to the tendencies of affection, mental capacity, longevity, and mental bent, or what cheiromants call ‘fate’ [10].
6. A line crossing the longevity line, a branch or break in it, interferes with its uniformity of the tendency to live [10].
7. Nerves regulating coarser and finer motions, and so creases or lines, contain chiefly motor fibres; but probably also other filaments transmitting in vibrations the resultant or combined effect of acquired and constitutional tendencies, and determining it to that part of the longevity line that will be affected, and there causing a crease resembling a cross by its junction with the main line or a branch, as the case may be [10].
8. The same train of reasoning obviously applies to avoidable accidents – that is, accidents caused by carelessness [10].
9. Unavoidable accidents. Certain tracts of cells in the conical grey matter, are, incredible as it may seem, probably affected by coming events, and made to vibrate; hence, vague fears, intuitive perception, but no actual train of reasoning . The vibrations excited in these cells cannot awaken the activity of the cells engaged in reasoning processes that adjoins them, but merely cause protoplasmic vibrations in them, these vibrations being transmitted and marked on hand by creases of different shapes. According to cheiromants, the left hand is what you are, constitutionally, the right hand, what you make yourself or acquire. We may, therefore, reasonably expect to see in the right hand the resultant of acquired and constitutional tendencies [10].
One more research regarding to prediction of disease is very popular. In Medical work, haematoma of the ear has been for a long time recognized. This consists in the upper portion of the ear assuming a peculiar shape, either by the formation of a blood tumour, or by the thickening of the upper portion, which is found in the ears of lunatics, generally those who inherit madness; but in Paris it was much more closely studied, with the result that tests were given before the Academie des sciences, proving that madness could be predicated years in advance by a proper study of the ear alone [10].

Almost all medical men admit now that the different formations of nails indicate different disease, and that is possible from the nails alone to predict that the subject will suffer from paralysis, consumption, heart disease, and so on [10].

Sir Richard Owen, in his work on “The Nature of Limbs”, said: “In the hand every single bone is distinguishable from one another; each digit has its own peculiar character” [10].

The research is also done about skin, nerves, and sense of touch of the palm.

Speaking of the skin, Sir Charles Bell once said: “The cuticle is so far a part of the organ of touch that it is the medium through which the external impression is conveyed to the nerve. The extremities of the fingers best exhibit the provisions for the exercise of this sense. The nails give support to the tips of the fingers, and in order to sustain the elastic cushion that forms their extremities they are made broad and shield-like. This cushion is an important part of the exterior apparatus. Its fullness and elasticity adapt it admirably for touch. It is a remarkable fact that we cannot feel the pulse with the tongue, but that we can with the fingers. On a nearer inspection we discover in the points of the fingers a more particular provision for adapting them to touch. Wherever the sense of feeling is most exquisite, there we see minute spiral ridges of the cuticle. These ridges have corresponding depressions on the inner surface, and they again give lodgment to soft, pulpy processes of the skin called papillae, in which lie the extremities of the sentient nerves. Thus the nerves are adequately protected, while they are at the same time sufficiently exposed to have impressions communicated to them through the elastic cuticle and thus give rise to the sense of touch.” [10].

In connection with this, it is important to consider the corpuscles that are found in the hand. Meissner, in his “Anatomy and Physiology of the Hand”, showed that these corpuscles in the hand have a very important meaning. He demonstrated that these “unyielding molecular substances” were found in the tips of the fingers, the lines of the hand, and disappeared completely at the wrist; that these corpuscles contained the end of
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the important nerve fibre, and during the life of the body gave forth certain crepitations or vibrations, which ceased the moment life became extinct. “I have counted,” says he, “in the first phalange of the volar surface of the forefinger of a full-grown man, one hundred and eight corpuscles, and about four hundred papillae in a square line.” [10].

We will now turn out attention to what, perhaps, as far as palmistry is concerned, may be the most important point of all, namely, as to the ideas of men of learning as regards a fluid or essence in connection with the nerves and the brain.

On this point Abercrombie stated: “The communication of perceptions from the sense to the mind has been accounted for by motions of the nervous fluid, by vibrations of the nerves, or by a subtle essence resembling electricity or galvanism.”

Muller also said: “Perhaps there exists between the phenomena of the nervous system and of electricity sympathy or connection at present unknown, analogous to that which has been found to exist between electricity and magnetism.” And again he said: “We know not as yet whether or not, when the nerves convey an impression, an imponderable fluid flies along them with inconceivable rapidity, or whether the action of the nervous system consists of an imponderable principle already existent in the nerves, and placed in vibration by the brain.” [10].

Professor Savary d’Odiardi, a well known French savant who devoted the greater part of his life to investigating the curative effect of electricity in disease, stated that he considered the nerves a kind of telegraph system in conveying the current of thought from the brain to the body, but more especially in their connection and relation to the hand [10].

Herder, in his “Idees sur la Philosophie de l’Histoire de l’Humanite”, published at Paris, 1827, wrote also in favor of this theory. He spoke of the action of the nervous fluid, which he taught is an essence far more subtle than that of electricity, and used to convey the impressions of the brain to the nerves [10].

All such opinions from well known men who devoted time and thought to the subject go far to show that the influence of the mind in this or that direction must affect the lines, the nails, and in fact every portion of the hand. There is nothing superstitious in such a theory; it is based upon the findings of science, and has been supported by facts that are undisputed [10].
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2.2.4.3 Existing Decision Support Systems for Palmistry

The researchers, all over the world are working in this area and developing different web applications for palmistry. There are mainly two types of applications found in the field of palmistry.

In the first type of applications, palm reader, who is a human being, is required. The procedure is very simple in this case. Users upload the image/s of their palm/s on the website of particular author. Mostly the author is palmist. Author studies the image/s at his/her machine. Based on his decisions, predictions are sent back to users via e-mail.

In other type of applications, some web sites show sample images of palm and tell users to compare their own palm with the most suitable one. Predictions are displayed based on the selection of image by user. It is users responsibility to identify the nearest matching image. In this case, palmist is not required for all the times. The knowledge of palmist is stored in the knowledge base. In the knowledge base, sample image and associated predictions are stored. Based on user’s selection, prediction is displayed to user.

2.2.4.4 Limitations of Existing Decision Support Systems

In spite of different domain, the systems mentioned in section 2.2.4.3 are helpful to this research work, by means of the study of their limitations. Collectively they have following limitations:

In first type of systems, the limitations are as follows:

(i) The process of palm image analysis is manual. Human eye is having so many limitations like less resolution power, subjectivity in color identification, and effect of background color in color identification process. Thus, predictions made by human eye may be wrong.

(ii) Because of manual work, process is very slow as compared to the speed of computer.

(iii) Human can get tired after some time, but computer can do endless job.

(iv) Manual process is error prone.

In second type of systems, the limitations are as follows:

(i) For the users, it is difficult to select perfect match of his/her palm. Because no two palms in the world are identical [10]. So there are no chances that user would find same palm on the website like his/her.

(ii) If the user selects wrong sample image then, predictions would be wrong.
(iii) The knowledge of only one expert is used for prediction. Mostly the expert is the owner of the website.

Apart of above limitations, there is one more technical limitations regarding to these systems. If the image is degraded during transfer on internet, predictions may go wrong.

### 2.2.5 Medical Palmistry

Introduction of medical palmistry is discussed in chapter 1. The healthy palms indicate good health of the person. Following points explain about healthy and unhealthy palms briefly.

The healthy hand has following features:

(i) Outline: a well made hand without excess in any particular, a firm, rather hard palm, clear skin, inclined to be dry rather than damp, large bright nails, pale in color, elastic but not brittle, the lunua (half moons on nails) very slightly marked, small, and nearly the same color as the rest of the nail. Mounts and finger tips very firm, no flabbiness, no depressions or dents in the flesh or muscles. The color of the hand should be even all over [8].

(ii) The lines: as mentioned in chapter 1, lines in the palm are directly governed by brain; their position indicates much about health. In a healthy palm, we find very few lines, deep, narrow, clear, and unbroken. The fewer the lines the less the subject is troubled, either physically or mentally [8].

The unhealthy hand has following features:

(i) Outline: an abnormal hand of any kind, crooked or twisted fingers, a flabby palm, a soft damp skin, brittle or too hard nails, either red or bluish white in color, deep half moons – white on red, or blue on white, ridges, spots, or dents on the nails. A badly colored skin with blue patches or red flushing in parts, indentations or depressions in wrong places, and the temperature of the hand either too hot or too cold [8].

(ii) The lines: abnormal lines, or a great quantity of small lines covering the palm, or thickly marked in any one space of it. Broken, dented, islanded, or discolored lines. Blue or black dents or dots appearing on any line. Very faint lines, disappearing gradually, or in places appearing rubbed out [8].

In the 2.2.5.1 and 2.2.5.2 sample images for abnormal nails and palms are shown, respectively.
2.2.5.1 Nails and Diseases

As discussed earlier in the chapter, nails are great indicators of health. Following figure shows internal structure of nail. Figure 2.1 (a) shows structure of human nails. Figure 2.1 (b) shows internal structure of nails by taking cross section of nail [4].

Relation between nails and brain is proved in the section 2.2.4.2. It is clearly seen in figure 2.1 (b) that color of nail (Nail plate) is because of nail bed. Flow of blood and biochemical fluids to this region would decide the color of nail. Therefore, careful study of nail color and lunula, could predict diseases. Following are some examples of nails with different colors and diseases associated with them.

(i) Red Nails: red nails generally indicate diseases like Infective endocarditis, trauma [4]. Sometimes full nails are not red, but they may have red flush on
them. This indicates internal delicacy [8]. Red nails with large white lunula indicate consumption (TB) [8]. Figure 2.2 (a) and Figure 2.2 (b) show samples of red nails.

(a) Individual and multiple red linear bands are noted on the fingers of the right hand of the 51 years old man with idiopathic polydactylos longitudinal erythronychia.

(b) Red nails

Figure 2.2: Red Nails [29], [28]

(ii) Blue Nails: Bluish nails indicate diseases like Lung problems, lack of oxygen, and heart problems [8]. Sometimes bluish color of nails predicts disease like Cyanosis, antimalarials, haematoma [4]. Figure 2.3 shows example of blue nails.

(a) Blue Nails

(b) Blue Nails

Figure 2.3 Blue Nails [30], [33]

(iii) White Nails: White nails are great indicators of Liver diseases like hepatitis or jaundice [8]. If whiteness of nails is very much it shows Hypoalbuminaemia [4]. Figure 2.4 shows example of white nails.
(iv) Yellow Nails: Yellow color of nails predicts diseases like Psoriasis, fungal infection, jaundice, and tetracycline [4]. Yellow nails could be divided into two classes dark yellow and light yellow. Dark yellow nails strongly show Psoriasis, Fungal Infection, Jaundice, Tetracycline, Diabetes, or Thyroid disease. If the nails are becoming thickened and crumble, then the situation is more serious. Light yellow nails also indicate the same situation, but it may be the initial stage of disease. Figure 2.5 shows images of dark and light yellow nails respectively.

(v) Pale Nails: Pale nails indicate the probability of diseases like Anemia, Malnutrition, Liver disease, or Congestive Heart failure, if precautions are not taken. Figure 2.6 shows sample of pale nails. One should be very careful while identification of pale nails, because their color is very much similar to light pink.
(vi) Black Line on Nail: Black lines on the nails indicate Melanoma which is a type of skin cancer [8]. Figure 2.7 shows example of melanoma.

Apart of nail color, there are some other factors which play important role in diagnosis of disease. To have more idea about diseases indicated by nails, one should observe shape of nail, surface of nail bed i.e. rough, smooth, pitted etc., whether the nail is brittle or not, clubbing, and skin around nail.

Clubbing: the majority of patients with finger clubbing have thoracic disease but it is also associated with gastrointestinal disorders [4]. Examples of clubbing are shown in Figure 2.8.

Figure 2.9 shows the images of nails which are taken as a reference for a diagnostic aid by medical practitioners [4].
This study shows the importance of nail analysis in the field of medical science.

2.2.5.2 Palm and Diseases
Medical practitioners observe palm of patient variously to get primary idea about disease. As mentioned earlier, palm contains maximum nerves from brain. Surface, temperature, color, and skin of palm reflect so many facts regarding to health of a person. Medical practitioners are advised to shake the hands with patients to get primary information to get diagnostic clues. Such clues are shown in table 2.1 [4].

<table>
<thead>
<tr>
<th>Information from Hand Shake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features</strong></td>
</tr>
<tr>
<td>Cold, sweaty hands</td>
</tr>
<tr>
<td>Cold, dry hands</td>
</tr>
<tr>
<td>Hot, sweaty hands</td>
</tr>
<tr>
<td>Large, fleshy, sweaty hands</td>
</tr>
<tr>
<td>Dry, coarse skin</td>
</tr>
<tr>
<td>Delayed relaxation of grip</td>
</tr>
<tr>
<td>Deformed hand/fingers</td>
</tr>
</tbody>
</table>

Table 2.1: Diagnostic Clues from Hand Shake [4]
Figure 2.10 shows internal structure of palm. One can see arteries, veins, muscles, and tissues in the palm in this figure. Flow of blood in these arteries will decide the color of palm. Therefore color of palm tells much about the health of palm. Moreover, careful observation of following figure shows that arteries and veins are networked in different regions of palm. In palmistry these regions are called mounts. These regions or mounts are made up of muscular tissues. The blood circulation up to these mounts will decide the color of each mount. It is possible that in the same palm, different regions may have different colors. Therefore, in palmistry as well as in medical science, study of palm is very important for initial diagnostics of disease.

Figure 2.10: Internal Structure of Human Palm [35]

The color of a normal palm is a light red or pinkish red with a shiny, smooth texture. If the color appears either darker or lighter than normal, this may indicate that the condition of health is abnormal. Following are examples of abnormal palm colors [9]:

(i) Pale White:

- A palm appearing pale white in colour indicates anaemia or possibly occult bleeding. [9].
- If the palm looks white, this usually indicates lung disease or inflammation in the body [9].

(ii) Blue:

- A Blue palm usually indicates intestinal obstruction [9].
(iii) Green:

- A Palm with a dark green colour usually indicates obstruction in the circulation of the blood [9].
- A greenish palm that is not dark may indicate anaemia or spleen/stomach disease [9].

(iv) Yellow:

- A sallow yellow palm usually indicates chronic disease. This is because chronic disease typically affects the spleen and stomach. Yellow is the colour of earth and the spleen and stomach pertain to earth. In this case, the spleen and stomach are vacuous and weak [9].
- A palm with a bright, golden yellow colour is often seen in the liver disease accompain by jaundice. In this case, there is liver/gallbladder damp heat [9].
- If the palm skin grows thicker, stiffer and is dry with a light yellow, shiny, smooth surface this is called palm calcar keratosis [9].
- A palm that looks yellowish brown and has no sheen indicates the possibility of cancer [9].

(v) Red:

- A palm with Red, net like capillaries often appears with Vitamin C deficiency.
- If the whole palm is covered with dark red or purple spots, this is usually seen in liver disease [9].
- When the skin on the surface of the palm and especially the thenar and hypothenar eminences and the fingertips appears congested red, this is commonly due to cirrhosis of the liver or cancer of the liver [9].
- The palm that first appears red and gradually changes to dark purple is usually a sign of heart disease. It is an indication that the disease is worsening. An excessively red palm indicates a tendency for apoplexy [9].
- If the whole palm of a hyper tenseive patient appears black like tea, this is forewarning of cerebral haemorrhage. If the skin of red palm is soft as satin, this indicates a tendency towards rheumatic fever. In general in Chinese medicine, red indicates the presence of heat. As the red becomes
darker, this indicates that heat is being complicated by stagnation and stasis [9].

(vi) Purple:

- When the subcutaneous tissue of the palm shows prune coloured purple, it indicates serious infectious shock [9].

(vii) Grey:

- Thin Cigarette-ash like spots on the palm are sign of heart disease in a heavy smoker [9].

(viii) Black:

- A palm that looks black is often seen in kidney disease [9].
- If the central part of the palm looks brownish –black, this often indicates gastrointestinal disease [9].
- A dark purple of black colour appearing from the wrist to the hypothenar eminence is a sign of low back disease due to wind. The same colour may also appear on the medical side of the foot and ankle [9].

Following are two sample images which show abnormal colouring and surfaces of palm. The diseases associative with each palm are named to give idea about relationship between palm and diseases. Figure 2.11 shows symptoms of Raynaud’s syndrome in human palm.

Figure 2.11: Raynaud’s Syndrome in Human Palm [4]

Figure 2.12 shows cases of Hypercarotenaemia. In this case, a yellowish discoloration is seen but not like jaundice.
Chapter – 2 Literature Survey and Scope of Research

Thus, one can understand the importance of palm in identification and prediction of diseases in medical science.

2.2.5.3 Mounts and Symbols in Palm

Overview of mounts and symbols which may found in human palm is given in chapter 1. In medical palmistry, position of symbols in palm is very important factor to decide or predict disease. Following are some sample disease, which could be caught by observing palm very carefully.

(i) Diphtheria: in case of diphtheria, with tracheotomy, and no paralysis, there was a blue dent on the Life line under the Mount of Jupiter, with an island under the break, also the Life line was broken again a little lower down [8].

(ii) Malaria: Malaria affects the Hepatic line, marking it with small blue dents, in serious cases, and with these small transverse islands will be found on the line of Life [8].

(iii) Hysteria: in case of hysteria and extreme nervous depression, we find a large proportion of the ling fingered pointed type, soft palmed and with poor thumbs, the hands covered with small lines, with the principal ones feathered and often broken, sometimes in bad cases with the lines piled on top of each other. The Mount of Luna will be affected; it is soft, high, and grilled [8].

Apart of these three diseases, almost all the diseases create some certain changes in palm.

This literature survey says that for prediction of diseases accurately, one should observe all the factors like mounts, symbols, type of palm, lines on palm, surface, color, nails of palm and collective analysis of all these factors.
2.3 Scope of Research
As discussed in this chapter, medical science and medical palmistry are two fields which study the human palms to identify and predict diseases. In medical science there is no dedicated system to analyze palms and nails to assist medical practitioners in their work. So, there is a great scope of research in development of decision support system for medical practitioners to assist them in the diagnosis work, combining the knowledge of medical science and medical palmistry. Moreover, if the system is online then, non medical practitioners i.e. common internet users can also get idea and advice about their health in advance.

There is a need of DSS to analyze nail and palms of human using image processing and analysis techniques.

2.4 Summary
This chapter presents introduction to existing decision support systems in medical science. Use of image processing in medical science is also discussed in the chapter along with their limitations. Literature survey about palmistry and medical palmistry is also part of this chapter. Science behind palmistry and existing computerized systems for palmistry are also described in this chapter. Many cases about nail, palm, and associated disease are shown by means of images in the chapter. At the end of the chapter scope of research in this area is discussed and need of the required work is identified.