Bull. Korean Math. Soc. **47** (2010), No. 3, pp. 503–511
DOI 10.4134/BKMS.2010.47.3.503

BROWDER'S TYPE STRONG CONVERGENCE THEOREM FOR S-NONEXPANSIVE MAPPINGS

Jong Kyu Kim, Daya Ram Sahu, and Sajid Anwar

Abstract. We prove a common fixed point theorem for S-contraction mappings without continuity. Using this result we obtain an approximating curve for S-nonexpansive mappings in a Banach space and prove Browder's type strong convergence theorem for this approximating curve. The demiclosedness principle for S-nonexpansive mappings is also established.

1. Introduction

Let C be a subset of a normed space X. A mapping $T : C \to X$ is said to be *nonexpansive* if

$$\|Tx - Ty\| \leq \|x - y\|$$

for all $x, y \in C$. Suppose $S : C \to X$ is a mapping. Then T is said to be S-*nonexpansive* if

$$\|Tx - Ty\| \leq \|Sx - Sy\|$$

for all $x, y \in C$. The class of S-nonexpansive mappings is a generalization of that of nonexpansive mappings [7].

In 1967, Browder [2] proved the following strong convergence theorem for nonexpansive mappings: Let C be a nonempty closed convex bounded subset of a Hilbert space H and $T : C \to C$ a nonexpansive self-mapping. Let $u \in C$ and for each $t \in (0, 1)$, let

$$G_t x = tu + (1 - t)Tx, \ x \in C.$$

Then G_t has a unique fixed point x_t in C and x_t converges strongly to a fixed point of T in C as $t \to 0$.

On the other hand, Shahzad [8] introduced the notion of R-subweakly commutativity which provides existence of a curve $\{x_\lambda\}$ in C defined by

$$x_\lambda = Sx_\lambda = (1 - \lambda)q + \lambda Tx_\lambda \text{ for all } \lambda \in (0, 1) \tag{1.1}$$

Received October 16, 2008.
2000 *Mathematics Subject Classification.* 47H09, 46B20, 47H10, 54H25.
Key words and phrases. demicontinuity, R-weakly commutativity, S-contraction mapping, S-nonexpansive mapping.
The first author was supported by the Kyungnam University Research Fund 2008.

for S-nonexpansive mappings (see Proposition 3.3).

In this paper, an important existence result as a significant improvement of a result of Shahzad [8] for S-contraction mappings without continuity is proved. This result is applied for existence of approximating curve $\{x_\lambda\}$ defined by (1.1) and existence of fixed points of S-nonexpansive mappings without continuity. Also we prove demiclosedness principle for S-nonexpansive mappings and prove strong convergence of curve $\{x_\lambda\}$ in a reflexive Banach space with a weakly continuous duality mapping. Our results are significant improvements of corresponding results of Al-Thagafi [1], Dotson [3], Jungck [4] and Shahzad [8]. One of our results is an extension of celebrated result of Browder [2] from Hilbert space to Banach space for the class of S-nonexpansive mappings.

2. Preliminaries

Let (X, d) be a metric space, C a nonempty subset of X and let $S, T : C \to C$ be two mappings. Throughout this paper, we adopt the following notations:

$$\mathcal{C}_{S,T} = \{u \in C : Su = Tu\}$$

and

$$F(T) = \{u \in C : Tu = u\}.$$

The pair $\{S, T\}$ is said to be *R-weakly commuting* on C [6] if there exists $R > 0$ such that

$$d(STx, TSx) \leq Rd(Sx, Tx)$$

for all $x \in C$.

Let C be a nonempty subset of a normed space X. The set C is called *q-starshaped* with $q \in C$ if for all $x \in C$, the segment $[x, p]$ joining x to q is contained in C, that is, $tx + (1-t)q \in C$ for all $x \in C$ and $0 \leq t \leq 1$. Note that if S is q-starshaped for every $q \in C$, then C is *convex*.

Let C be a nonempty q-starshaped subset of a normed space X. Then a mapping $S : C \to C$ is said to be *q-affine* if

$$tSx + (1-t)Sq \in C$$

for all $x \in C$ and $0 \leq t \leq 1$.

Definition 2.1. Let C be a nonempty subset of a normed space X and let $S, T : C \to C$ be two mappings such that $F(S) \neq \emptyset$. Suppose $q \in F(S)$ and C is q-starshaped. Then S and T are called *R-subweakly commuting on C* if there exists a real number $R > 0$ such that

$$\|STx - TSx\| \leq Rd(Sx, [Tx, q])$$

for all $x \in C$, where $d(y, D) = \inf\{\|y - z\| : z \in D\}$ for $D \subseteq C$ and $y \in C$.

It is clear from Definition 2.1 that commutativity implies R-subweak commutativity, but the converse is not true in general (see, example in [8]).

Let C be a nonempty subset of a normed space X and $T : C \to C$ a mapping. When $\{x_n\}$ is a sequence in X, we denote the strong convergence of $\{x_n\}$ to

x by $x_n \to x$, the weak convergence of $\{x_n\}$ to x by $x_n \rightharpoonup x$ and the weak* convergence of $\{x_n\}$ to x by $x_n \rightharpoonup^* x$. T is said to be *demicontinuous* if $\{x_n\}$ is a sequence in X such that $x_n \to x$, then $Tx_n \rightharpoonup Tx$. The mapping T is said to be *weakly continuous* if $\{x_n\}$ is a sequence in X such that $x_n \rightharpoonup x$, then $Tx_n \rightharpoonup Tx$. Note that every continuous mapping is demicontinuous.

Let X be a Banach space. A mapping T with domain $D(T)$ and range $R(T)$ in X is said to be *demiclosed* at a point $y \in R(T)$ if whenever $\{x_n\}$ is a sequence in $D(T)$ which converges weakly to a point $u \in D(T)$ and $\{Tx_n\}$ converges strongly to y, then $Tu = y$.

A Banach space X is said to satisfy *the Opial condition* ([5]) if for each sequence $\{x_n\}$ in X which converges weakly to a point $x \in X$, we have

$$\liminf_{n\to\infty} \|x_n - x\| < \liminf_{n\to\infty} \|x_n - y\|$$

for all $y \in X, y \neq x$.

Let X be a Banach space. Then a mapping $J : X \to 2^{X^*}$ defined by

$$J(u) = \{j \in X^* : \langle u, j\rangle = \|u\|^2, \|j\| = \|u\|\}$$

is called the normalized duality mapping. Suppose that J is single-valued. Then J is said to be *weakly sequentially continuous* if, for each $\{x_n\}$ in X with $x_n \rightharpoonup x$, $J(x_n) \rightharpoonup^* J(x)$. It is well known that if X admits a weakly sequentially continuous duality mapping, then X satisfies the Opial condition.

3. Auxiliary results

The following lemma is an improvement of Lemma 2.1 of Shahzad [8] in the following ways:
(i) C is not necessarily closed,
(ii) T is not necessarily continuous,
(iii) location of unique common fixed point is given.

Lemma 3.1. *Let (X, d) be a metric space and C a nonempty subset of X. Let $S, T : C \to C$ be two mappings such that*

(i) *$T(C) \subseteq S(C)$,*
(ii) *T is S-contraction, i.e., there exists a constant $k \in (0, 1)$ such that*

$$\|Tx - Ty\| \leq k\|Sx - Sy\| \text{ for all } x, y \in C,$$

(iii) *$\{S, T\}$ is R-weakly commuting on C.*

Then we have the following:
(a) *$F(S) \cap F(T) \cap T(C)$ is a singleton if $T(C)$ is complete,*
(b) *$F(S) \cap F(T) \cap S(C)$ is a singleton if $S(C)$ is complete.*

Proof. Pick $x_0 \in C$. Since $T(C) \subseteq S(C)$, we can construct a sequence $\{x_n\}$ in C such that $Sx_n = Tx_{n-1}$ for all $n \in \mathbb{N}$. Then

$$d(Sx_{n+1}, Sx_n) = d(Tx_n, Tx_{n-1}) \leq kd(Sx_n, Sx_{n-1}) \text{ for all } n \in \mathbb{N},$$

it follows that $\{Sx_n\}$ is a Cauchy sequence in C.

(a) If $T(C)$ is complete, there exists a point $z \in T(C)$ such that $Tx_n \to z \in T(C)$. Thus, $Sx_n \to z$. Since $z \in T(C) \subseteq S(C)$, there exists $u \in C$ such that $z = Su$. By the S-contractivity of T, we have

$$d(Tu, Tx_n) \leq kd(Su, Sx_n).$$

Taking limit as $n \to \infty$ yields

$$d(Tu, z) \leq kd(z, z) = 0.$$

Thus, $Su = Tu = z$. Since $\{S, T\}$ is R-weakly commuting on C, it follows that $Sz = Tz$. Note that

$$d(Tz, Tx_n) \leq kd(Sz, Sx_n).$$

Letting limit as $n \to \infty$, we obtain

$$d(Tz, z) \leq kd(Sz, z) = kd(Tz, z).$$

It shows that $Sz = Tz = z$. By the S-contractivity of T, we conclude that $F(S) \cap F(T) \cap T(C) = \{z\}$.

(b) Suppose $S(C)$ is complete. Then $Sx_n \to z$ for some $z \in S(C)$ and there exist $u \in C$ such that $z = Su$. As part (a) we can show that $Sz = Tz = z$. The S-contractivity of T implies that $F(S) \cap F(T) \cap S(C) = \{z\}$. □

Before presenting existence results, we establish the demiclosedness principle for S-nonexpansive nonself mappings.

Proposition 3.2 (Demiclosedness principle)**.** *Let X be a Banach space satisfying the Opial condition and C a nonempty weakly closed subset of X. Let $S, T : C \to X$ be two mappings such that S is weakly continuous and T is S-nonexpansive. Then $S - T$ is demiclosed on C, i.e., if $\{x_n\}$ is a sequence in C such that $x_n \rightharpoonup u \in C$ and $(S - T)x_n \to y$, then $(S - T)u = y$.*

Proof. Let $\{x_n\}$ be a sequence in C such that $x_n \rightharpoonup u \in C$ and $\lim_{n\to\infty} \|(S - T)x_n - y\| = 0$ for some $y \in X$. We show that $(S - T)u = y$. Suppose, for contradiction, that $(S - T)u \neq y$. Observe that

$$\|Sx_n - Tu - y\| \leq \|Sx_n - Tx_n - y\| + \|Tx_n - Tu\|,$$

which implies that

$$\liminf_{n\to\infty} \|Sx_n - Tu - y\| \leq \liminf_{n\to\infty} \|Sx_n - Su\|.$$

By the weak continuity of S, we obtain that $Sx_n \rightharpoonup Su \in C$. By the Opial condition, we have

$$\begin{aligned}\liminf_{n\to\infty} \|Sx_n - Su\| &< \liminf_{n\to\infty} \|Sx_n - Tu - y\| \\ &\leq \liminf_{n\to\infty} \|Sx_n - Su\|,\end{aligned}$$

a contradiction. Therefore, $(S - T)u = y$. □

Proposition 3.3. *Let C be a nonempty subset of a normed space X. Let $S, T : C \to C$ be two mappings such that*

(i) *T is S-nonexpansive and S is q-affine with $q \in F(S)$,*
(ii) *$T(C) \subseteq S(C)$ and C is q-starshaped,*
(iii) *$\{S, T\}$ is R-subweakly commuting,*
(iv) *$S(C)$ is complete.*

Then there exists exactly one point $x_\lambda \in S(C)$ such that

$$x_\lambda = Sx_\lambda = (1-\lambda)q + \lambda T x_\lambda \tag{3.1}$$

for all $\lambda \in (0, 1)$.

Proof. For each $\lambda \in (0, 1)$, define a mapping T_λ by

$$T_\lambda x = (1-\lambda)q + \lambda T x \tag{3.2}$$

for all $x \in C$. Note that each $T_\lambda : C \to C$ is an S-contraction on C. Indeed,

$$\begin{aligned}\|T_\lambda x - T_\lambda y\| &= \lambda\|Tx - Ty\| \\ &\leq \lambda\|Sx - Sy\|\end{aligned}$$

for all $x, y \in C$. Since $\{S, T\}$ is R-subweakly commuting and S is q-affine, we have

$$\begin{aligned}\|ST_\lambda x - T_\lambda Sx\| &= \|[(1-\lambda)q + \lambda STx] - [(1-\lambda)q + \lambda TSx]\| \\ &= \lambda\|TSx - STx\| \\ &\leq \lambda R\|Sx - T_\lambda x\|\end{aligned}$$

for all $x \in C$. Thus, the pair $\{S, T_\lambda\}$ is R-weakly commuting on C.

For $x \in C$, we have $Tx \in T(C) \subseteq S(C)$, i.e., there exists a point $y \in C$ such that $Tx = Sy \in S(C)$. Observe that

$$T_\lambda x = (1-\lambda)q + \lambda Tx = (1-\lambda)q + \lambda Sy \in S(C).$$

It follows that $T_\lambda(C) \subseteq S(C)$ for all $\lambda \in (0, 1)$.

For each $\lambda \in (0, 1)$, we conclude that

(i)$'$ $T_\lambda(C) \subseteq S(C)$,
(ii)$'$ T_λ is S-contraction,
(iii)$'$ $S(C)$ is complete,
(iv)$'$ $\{S, T_\lambda\}$ is R-weakly commuting on C.

Therefore, Lemma 3.1 implies that there exists exactly one point $x_\lambda \in S(C)$ such that $x_\lambda = Sx_\lambda = T_\lambda x_\lambda$. □

The main results of this section are the following:

Theorem 3.4. *Let C be a nonempty subset of a normed space X. Let $S, T : C \to C$ be two mappings satisfy the conditions* (i) $\sim$ (iii) *of Proposition 3.3. Suppose $S(C)$ is compact. Then we have the following*:

(a) *There exists $y \in S(C)$ such that $Sy = Ty$.*
(b) *If S or T is demicontinuous, then $y \in F(S) \cap F(T)$.*

Proof. Let $\{\lambda_n\}$ be a sequence in (0,1) such that $\lambda_n \to 1$. By Proposition 3.3, there exists exactly one point $x_{\lambda_n} \in S(C)$ such that

$$x_{\lambda_n} = Sx_{\lambda_n} = (1-\lambda_n)q + \lambda_n Tx_{\lambda_n} \text{ for all } n \in \mathbb{N}.$$

Set $x_{\lambda_n} := x_n$. By the compactness of $S(C)$, there exists a subsequence $\{\lambda_m\}$ of $\{\lambda_n\}$ such that $\lim_{m\to\infty} Sx_m = y \in S(C)$. Thus, $y = Su$ for some $u \in C$. The assumption (ii) implies that $\{Tx_m\}$ is bounded. It follows that

$$\|x_m - Tx_m\| \leq (1-\lambda_m)\|q - Tx_m\| \to 0 \quad \text{as } m \to \infty.$$

This gives that $\lim_{m\to\infty} Tx_m = y$. By S-nonexpansiveness of T, we have

$$\|Tx_m - Tu\| \leq \|Sx_m - Su\| = \|Sx_m - y\|.$$

Taking limit as $m \to \infty$ yields $Tu = y$.

(a) Since $\{S, T\}$ is R-weakly commuting, it follows that $Sy = Ty$.

(b) Suppose S is demicontinuous. Since $\lim_{m\to\infty} x_m = \lim_{m\to\infty} Sx_m = y$, it follows from the demicontinuity of S that $Sy = y$. Thus, we conclude from $Sy = Ty$ that $y \in F(S) \cap F(T)$. Similarly, we can prove that $y \in F(S) \cap F(T)$ when T is demicontinuous. □

Example 3.5. Let $X = [0, 1]$ with the usual metric and $C = X$. Define

$$Sx = \begin{cases} 0 & \text{if } \; x \in [0,1), \\ 1 & \text{if } \; x = 1 \end{cases} \quad \text{and } \; Tx = 0 \text{ for all } x \in C.$$

Then all hypotheses of Theorem 3.4 are satisfied. Note that $0 \in F(S) \cap F(T)$.

Remark 3.6. The mapping S in Theorem 3.4 is not necessarily linear. Therefore, Theorem 3.4 improves Theorem 2.2 of Al-Thagafi [1], Theorem 1 of Dotson [3], Theorem 3.1 of Jungck [4] and Lemma 2.2 of Shahzad [8].

Theorem 3.7. *Let C be a nonempty subset of a Banach space X. Let $S, T : C \to C$ be two mappings satisfying conditions* (i) $\sim$ (iii) *of Proposition* 3.3. *Suppose $S(C)$ is weakly compact. Then $F(S) \cap F(T) \neq \emptyset$ if one of the following conditions holds*:

(C_1) *$I - T$ is demiclosed at zero.*

(C_2) *X satisfies the Opial condition.*

Proof. Let $\{\lambda_n\}$ be a sequence in (0,1) with $\lambda_n \to 1$. Since $S(C)$ is weakly compact, it follows that $S(C)$ is norm-closed and hence it is complete. Then form Proposition 3.3, there exists exactly one point x_n such that

$$x_n = Sx_n = (1-\lambda_n)q + \lambda_n Tx_n \quad \text{for all } n \in \mathbb{N}.$$

The condition $T(C) \subseteq S(C)$ implies that $T(C)$ is bounded and hence $x_n - Tx_n \to 0$. By the weak compactness of $S(C)$, there exists a subsequence $\{x_{n_i}\}$ of $\{x_n\}$ such that $x_{n_i} \rightharpoonup v$. The weak continuity of S implies that $v = Sv$.

If $I - T$ is demiclosed at zero, then $v = Tv$ and hence theorem is proved. If we assume that X satisfies the Opial condition, then we can conclude form Proposition 3.2 that $Sv = Tv$. □

Remark 3.8. The main results of this section can be extended in complete p-normed spaces.

4. Browder's type strong convergence theorem

The following result extends Browder's strong convergence theorem for S-nonexpansive mappings.

Theorem 4.1. *Let X be a reflexive Banach space with a weakly continuous duality mapping $J : X \to X^*$. Let C be a weakly closed subset of X, $S : C \to C$ a affine weakly continuous mapping with $q \in F(S)$ such that C is q-starshaped. Let $T : C \to C$ be an S-nonexpansive mapping with $\mathcal{C}_{S,T} \neq \emptyset$ and let $\{x_\lambda : \lambda \in (0,1)\}$ be the approximating curve in C defined by* (3.1). *Then $\lim_{\lambda\to1} x_\lambda = \tilde{x}$ exists and $\tilde{x} \in F(S) \cap F(T)$.*

Proof. First, we show that $\{x_\lambda\}$ is bounded. Let $p \in \mathcal{C}_{S,T}$. Then $Sp = Tp = u$ for some $u \in C$. From (3.1), we have

$$\begin{aligned} \|x_\lambda - u\| &\leq (1-\lambda)\|q-u\| + \lambda\|Tx_\lambda - Tp\| \\ &\leq (1-\lambda)\|q-u\| + \lambda\|Sx_\lambda - Sp\| \\ &= (1-\lambda)\|q-u\| + \lambda\|x_\lambda - u\|, \end{aligned}$$

which implies that

$$\|x_\lambda - u\| \leq \|q-u\|.$$

Thus, $\{x_\lambda\}$ is bounded. Assume that $\{\lambda_n\}$ is a sequence in (0,1) such that $\lim_{n\to\infty} \lambda_n = 1$ and $\{x_{\lambda_n}\}$ is bounded. Since X is reflexive, we may assume that $x_{\lambda_n} \rightharpoonup v \in C$. Set $x_{\lambda_n} := x_n$. Again, from (3.1), we have

$$\|x_n - Tx_n\| \leq (1-\lambda_n)\|q - Tx_n\| \to 0.$$

On the other hand, we have

$$\begin{aligned} \langle x_\lambda - Tx_\lambda, J(x_\lambda - u)\rangle &= \langle x_\lambda - u + Tp - Tx_\lambda, J(x_\lambda - u)\rangle \\ &= \|x_\lambda - u\|^2 - \langle Tx_\lambda - Tp, J(x_\lambda - p)\rangle \\ &\geq \|x_\lambda - u\|^2 - \|Tx_\lambda - Tp\|\ \|x_\lambda - u\| \\ &\geq \|x_\lambda - u\|^2 - \|Sx_\lambda - Sp\|\ \|x_\lambda - u\| \\ &= 0. \end{aligned} \tag{4.1}$$

Since $x_\lambda - Tx_\lambda = \frac{1-\lambda}{\lambda}(q - x_\lambda)$, it follows from (4.1) that

$$\langle x_\lambda - q, J(x_\lambda - u)\rangle \leq 0. \tag{4.2}$$

Since S is weakly continuous, $x_n \rightharpoonup v \in C$ and $Sx_n - Tx_n \to 0$, we obtain from Proposition 3.2 that $Sv = Tv$. Suppose that $Sv = Tv = w$ for some $w \in C$. Using (4.2), we get

$$\langle x_n - q, J(x_n - w)\rangle \leq 0. \tag{4.3}$$

From (4.3), we have

$$\begin{aligned} \|x_n - w\|^2 &= \langle x_n - w, J(x_n - w)\rangle \\ &= \langle x_n - q, J(x_n - w)\rangle + \langle q - w, J(x_n - w)\rangle \\ &\leq \langle q - w, J(x_n - w)\rangle. \end{aligned} \tag{4.4}$$

Since J is weakly continuous, it follows from (4.4) that $x_n \to w$ as $n \to \infty$. Note that the weak continuity of S implies that $x_n = Sx_n \rightharpoonup Sw$. By the uniqueness of weak limit of $\{x_n\}$, we have $Sw = w$. Observe that

$$\begin{aligned} \|w - Tw\| &\leq \|w - x_n\| + \|x_n - Tx_n\| + \|Tx_n - Tw\| \\ &\leq \|w - x_n\| + \|x_n - Tx_n\| + \|Sx_n - Sw\| \\ &\leq 2\|w - x_n\| + \|x_n - Tx_n\| \to 0 \text{ as } n \to \infty. \end{aligned}$$

Thus, $w = Sw = Tw$.

Now, it remains to prove that the approximating curve $\{x_\lambda\}$ converges strongly to w. Suppose, for contradiction, that there exists another sequence $\{x_{\lambda_{n'}}\} \subset \{x_\lambda\}$ such that $x_{\lambda_{n'}} \to w' \neq w$ as $\lambda_{n'} \to 1$. Then, we have $w' \in F(S) \cap F(T)$. From (4.2), we have

$$\langle x_\lambda - q, J(x_\lambda - p)\rangle \leq 0 \text{ for all } p \in F(S) \cap F(T). \tag{4.5}$$

Using (4.5), we have

$$\langle w - q, J(w - w')\rangle \leq 0 \text{ and } \langle q - w', J(w - w')\rangle = \langle w' - q, J(w' - w)\rangle \leq 0.$$

Adding these two inequalities, we obtain

$$\|w - w'\|^2 = \langle w - w', J(w - w')\rangle \leq 0.$$

Thus, $w = w'$. Therefore, $\lim_{\lambda\to 1} x_\lambda$ exists and $\lim_{\lambda\to 1} x_\lambda = w \in F(S) \cap F(T)$. □

Remark 4.2. Nonemptyness of $\mathcal{C}_{S,T}$ can be replaced by boundedness of $T(C)$.

References

[1] M. A. Al-Thagafi, *Common fixed points and best approximation*, J. Approx. Theory **85** (1996), no. 3, 318–323.

[2] F. E. Browder, *Convergence of approximants to fixed points of nonexpansive non-linear mappings in Banach spaces*, Arch. Rational Mech. Anal. **24** (1967), 82–90.

[3] W. G. Dotson, Jr., *Fixed point theorems for non-expansive mappings on star-shaped subsets of Banach spaces*, J. London Math. Soc. (2) **4** (1972), 408–410.

[4] G. Jungck, *Coincidence and fixed points for compatible and relatively nonexpansive maps*, Internat. J. Math. Math. Sci. **16** (1993), no. 1, 95–100.

[5] Z. Opial, *Weak convergence of the sequence of successive approximations for nonexpansive mappings*, Bull. Amer. Math. Soc. **73** (1967), 591–597.

[6] R. P. Pant, *Common fixed points of noncommuting mappings*, J. Math. Anal. Appl. **188** (1994), no. 2, 436–440.

[7] S. Park, *On f-nonexpansive maps*, J. Korean Math. Soc. **16** (1979), no. 1, 29–38.

[8] N. Shahzad, *Invariant approximations and R-subweakly commuting maps*, J. Math. Anal. Appl. **257** (2001), no. 1, 39–45.

Jong Kyu Kim
Department of Mathematics Educations
Kyungnam University
Kyungnam 631-701, Korea
E-mail address: jongkyuk@kyungnam.ac.kr

Daya Ram Sahu
Department of Mathematics
Banaras Hindu university
Varanasi-221005, India
E-mail address: drsahu@bhu.ac.in

Sajid Anwar
Anjuman College of Engineering and Technology
Mangalwari Bazar Road, Sadar, Nagpur-1, India
E-mail address: sajid_anwar@sify.com