

Easy Rider

Easy Rider Navigation System: In the Pursuit of Riding

Part 1 - Understanding the Problem

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Overview

An overview of what the system will do and why it is needed

Bicycle riders all have one thing in common: they need to know where they're going when they hit the road. Using our Easy Rider, a cyclist simply defines a set of routes using built-in maps and waypoints. With Easy Rider a rider is free to do what he/she really wants to do, enjoy the ride!

While riding, Easy Rider displays the rider's current position with respect to the next waypoint. As a turn approaches, the system actively tells the rider when and where to turn. Whenever the need arises, the rider will query Easy Rider for local points of interest or to locate important resources such as food, water, rest stops, bike shops, communication, emergency aid, campgrounds.

Here are some of the "riding" advantages of the Easy Rider Navigation System:

- Focus your attention on the ride, and let the system tell you when and where to turn.
- Know exactly where you are, and precisely where you're heading, *all of the time*.
- Provides much more information than the maps and cue sheets typically provided. Plus, it's always up to date.
- Change your route on the fly, just because, *and never get lost*.
- Locate important resources while on the road, and the shortest way to reach them.

Now we all know that the most important factor for a rider is Safety First! Here's how Easy Rider solves some of the existing safety issues:

- No more fumbling with maps and cue sheets while riding. Easy Rider lets you keep your attention on the road and your hands on the handlebars.
- Tired (literally) of having to ride those extra miles because you failed to take a turn. Minimize the fatigue factor with Easy Rider.
- Need to find water, or medical help fast? Easy Rider will take you to the closest stop via the shortest route.
- Are you lost, and don't know how to tell your friends where to find you? With Easy Rider you always know!

Besides the above advantages during a ride, Easy Rider's Navigation System allows you to:

- Download routes posted by other riders from the web, and verify against current mapping information.
- Post your routes on the Internet for other riders to use.
- Record your ride while riding, and upload to your pc for analysis

User Profile

A description of the important characteristics of the users of the system

What all bicycle riders have in common is that they ride a bike. We have identified several different categories of cyclists:

- **Mountain:** These cyclists use a mountain bike and their main areas of biking are off-road terrains. Experiencing nature and the challenge of difficult paths are important aspects.
- **Commuter:** The commuters mainly uses their bike to go to work or to school and back home again. They know their route(s). The main concern is easy and reliable transportation.
- **Race:** In this category are all the cyclists that use their bike to participate in races or to prepare. They want to improve their physical and mental abilities for bike racing.
- **Touring:** Touring cyclists are people who wish to explore the world around them via bicycle. They do this in variable size groups of cyclists who share the same interests. They see cycling as not only an athletic activity but also as an occasion to socialize.
- **Fitness/Training:** Here, we have all the cyclists who want to do something for their health or who want to improve their endurance and performance for other sports.

In our project, we concentrate on a user like a member of the Southern Bicycle League or the SBL (<http://www.bikesbl.org/>). On their homepage they characterize themselves as follows:

“Whether you're new to cycling or a veteran rider, membership in Atlanta's Southern Bicycle League will add to your enjoyment of cycling. Learning from other riders, experiencing the thrill of new rides, and enjoying the camaraderie are benefits that last a lifetime. You'll also have the opportunity to help other cyclists and educate the community on cycling issues by getting involved in the club's many activities, such as the Advocacy Committee or by leading a ride.”

Key Characteristics of the User

- Likes to ride a bike
- Wants to share route and bike information
- 16-70 years old
- Enjoys social contact
- Educated / Sophisticated
- Familiar with computers

Members of the SBL belong somewhere between the touring and the fitness/training category. In cycling they are attracted not just to the fitness aspect but also to the social one. They want to cycle with people who have the same interests. The users also enjoy sharing their experiences and knowledge, e.g. information on nice routes, good places to stop, and cool bike technology. They all like the outdoors. Although they often ride in groups, they are each responsible for themselves. Cycling is very much an individualistic sport.

Most of the users have a small bike computer so that they have some information about their performance (speed, average speed, max. speed, distance time etc.).

There are members of all ages, but the average member is in his/her forties. In our user group there are well trained users as well as less trained ones, the age factor might be a reason for this. According to the president of the Southern Bicycle League, most riders in his organization are fairly sophisticated and educated; computers are not unknown to them.

The time they spend on their bikes for a tour varies from as short as one hour for brief evening ride to as long as two days for a weekend, but generally the ride distance is between 30 and 60 miles. They normally ride on roads, in contrast to mountain bikers.

All our interview subjects were interested in their performance. They all write down the statistics (average speed, distance, time etc.) and compare it to older data. They want to know if there is a progress in their physical fitness and they want to keep track of the distance they have ridden at the end of the year.

User Tasks

A description of the important characteristics of the tasks performed by the users

There are two different classes of users, riders and ride leaders. Typically, a volunteer ride leader organizes and “leads” a group of riders on a route (or set of routes) which the ride leader has defined.

The ride leader must first plan the route, usually with some alternatives based on distance. When defining the route, the ride leader will:

1. pick an area to ride in
2. pick a convenient starting point
3. locate place(s) to stop for water and/or food
4. look for routes with little traffic as well as nice scenery
5. prepare a map of the route and/or a cue sheet

During the process the ride leader will ride possible routes, either in a car or on a bike. The ride leader will iteratively reach a final set of routes and stops that meet his/her criteria for the ride. Once the ride is defined, the ride leader writes up a description and advertises it in SBL’s magazine, specifying a date and time, starting location, distance(s),

and a description of the ride. Examples of an advertisement, a map, and a cue sheet are shown in figures 2-4. Before a specific ride, the ride leader may or may not reconnoiter the route to make sure the conditions continue as previously thought. They will sometimes get feedback from other riders or ride leaders regarding any additional information.

Riders interested in going on a ride can search SBL's web site and/or the magazine. No signup or reservation is required. On the day of the ride, interested riders will meet the ride leader at the appointed time and place. Before the ride, the ride leader:

1. Gives a copy of the map to the riders
2. Explains the route and the important points of interest (store stops, bike shop, restaurants, scenic stops)
3. Gives a safety briefing – warn about difficult riding conditions (traffic, construction)
4. Specifies the place(s) to meet for lunch or to take a break

This will likely be the only time the whole group is together, unless they agree to meet at some point during or after the ride. Once the ride starts, each rider will determine the pace they will ride at, and the actual route they will follow. During the ride some users will choose to ride alone, while others will stay together in smaller groups.

While riding, each rider is essentially “on their own”, and is individually responsible for following the route. To do so, a rider will use the information provided by the ride leader and decide when and where to turn. A rider will occasionally look at the map (and/or cue sheet). If a glance is not enough, or the rider is not experienced, then they will stop and take a closer look. Sometimes a rider will take a wrong turn, or fail to take a turn. They'll often ride for a while before realizing they're no longer on the route. At that point they must attempt to backtrack, and reach the point where they deviated from the route. Since the map gives very little detail, some riders will end up asking for directions from people they see.

On the longer rides, riders (and the ride leader) will stop at the designated water stops, as well as get together with the other riders for lunch or for a break. While the goal is for all riders to get together at certain stops, this is not a requirement, and little attention is paid if a rider doesn't show. Once the ride is over, the riders may again meet up and spend some time together.

Task Environment

A description of the important characteristics of the task environment

When looking at the environment that the rider must operate in, there are three main factors: External, internal (the rider), and the equipment (the bicycle).

External factors

Weather

- **Temperature.** If the temperature is too hot, the rider may be faced with heat stroke and dehydration. Too cold, and the rider may cramp or sustain frostbite.
- **Humidity.** Rain can make the rider uncomfortable, saturate all of the rider's belongings, and take away from the pure enjoyment of the ride.
- **Wind.** If the rider has to go into a strong headwind, rider fatigue can become a serious problem, even on shorter rides. A strong tailwind, however, can make the ride easier for the rider.
- **Sunlight.** With the sun, if it is too bright a rider may have to wear sunscreen and parts of the bike may become very hot. If the sun is going down, it may be too dark for the rider to view a map or observe their surroundings.

Other humans. Humans operate in various ways in the rider's environment.

- **Vehicles.** Vehicles can become a major problem in some areas. On a hilly country road, riders have to be concerned with if the vehicles can see them. If a vehicle doesn't see them, then the riders are in danger of being hit. In traffic situations, a rider may have to weave between cars or wait in the traffic to get somewhere.
- **Other riders.** Other riders can cause accidents, suggest new routes, or perform other actions. An example of a problem is if the riders are in a group, and one of the riders in the front of the group crashes. The rest of the riders may also crash trying to avoid the first rider.
- **Pedestrians.** Pedestrians can also distract a rider, or get in their way. They may also steal the bikers' or some equipment.

Roads

- **Road conditions.** If a road is closed or under construction, the rider may have to find another route.
- **Road signs.** If the road sign is missing, a rider may miss a turn and become lost.
- **Visibility.** If the rider is on a road where the rider can not observe much of the road in front or behind them, they may be in danger of being hit by vehicles, or missing a turn.
- **Topography.** Elevation of roads changes, and the riders need to adapt to the differences.

Internal Factors

- **Fatigue.** This can limit the distance that a rider can go in a given day. Fatigue can also be influenced by weather, and the activities of the last few days of the rider. On multiple day tours, riders sleep to help reduce

fatigue. Getting lost also can contribute to fatigue, as the rider may have to travel a farther distance than intended.

- **Hunger.** Riders are people, and need to be nourished when participating in long tours. Riders need to know where to stop for food, or bring their own.
- **Athletic ability.** Rider's athletic ability can determine the level of difficulty of a ride that they can complete.
- **Multitasking.** Riders need to be able to deal with multiple information sources quickly. Visual, audio, and other inputs are constantly distracting the rider. Also while riding, they may need to read a map, call another rider, deal with traffic, or eat some food.
- **Mentality.** The rider may not feel like completing the route, or want to go on another route. There are many thoughts that the rider could have that would influence their decisions and performance.

Equipment

- **The bicycle.** Riders must depend on their bicycle to be mechanically sound. Problems can arise in the bike that include a flat tire, a broken chain, bad brakes, and other problems.
- **Accessories.** This included helmet, gloves, glasses, clothes, and other items a rider may have.

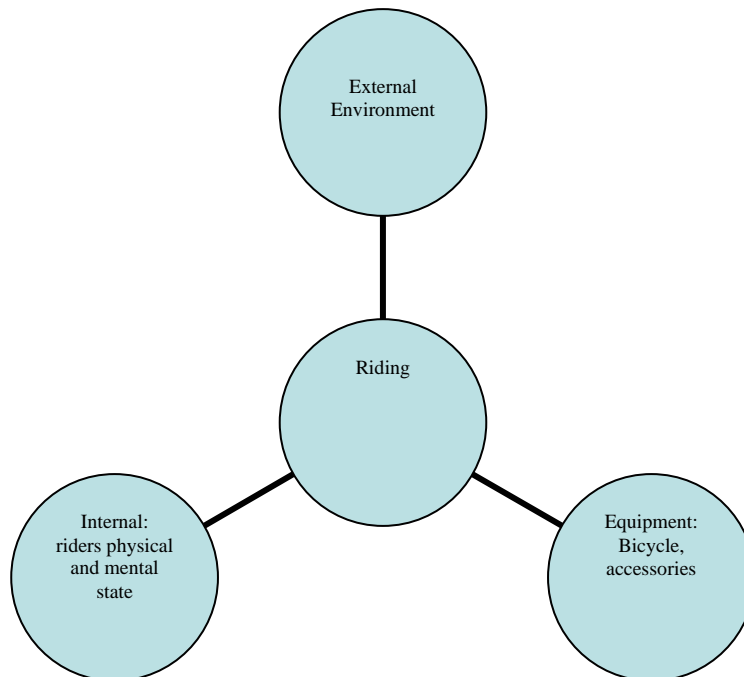


Figure 1 *Diagram of the relationship of the task environment to riding*

Entity-Relationship-Based Task Analysis

A simple structured task analysis of the problem

Following is an analysis of the problem space using entity-relationship-based techniques.

Object rider human actor

Attribute:

riding experience – beginner to experienced
ability to read map and follow direction – none to excellent
technical sophistication – generally high
multitasking ability
limitation of using eyes, ears, hands during ride
resistance to fatigue

Action:

R1: ride
R2: look for the ride in the SBL magazine or website
R3: meet at starting point
R4: read map
R5: follow the route
R6: look for points of interest
R7: stop

Object leader human actor

Attribute:

riding experience – experienced
ability to read map and follow direction – excellent
technical sophistication – high
multitasking ability
limitation of using eyes, ears, hands during ride
resistance to fatigue

Action: as rider

L1: ride
L2: look for the ride in the SBL magazine or website
L3: meet at starting point
L4: read map
L5: follow the route
L6: look for points of interest
L7: stop

Action: as leader

L8: research route
L9: prepare a map of the route
L10: advertise the ride in the SBL magazine or website
L11: give a copy of the map to the other riders
L12: explain the route and the important points of interest
L13: give a safety briefing
L14: specify the place to meet for lunch or to take a break

Object bicycle simple

Attribute:

limitation of weight capacity
exposure to elements
possibility of mechanical problem
various type

Object points of interest composite

Comprises:{rest stop, bike shop, scenery, restaurant, restroom}

Object paper based info composite

Comprises:{map, cue sheet}

Attribute:

fragility
difficulty of reading and update

Object accessories composite

Comprises:{helmet, tire changing tools, water, food, clothes, first aid kit}

Object road composite

Attribute:

paved
unpaved
icy
wet
bumpy
steep
curvy

Object sign composite

Comprises:{road sign, traffic sign, land mark, milepost}

Attribute:

possibility of inaccuracy

Object information sources composite

Comprises:{internet, publication, club, tour package, bike shop}

Attribute:

accuracy/timeliness of information not guaranteed
club dues to become a member
expensive tour package

Events

Ev1: inclement weather
Ev2: nightfall
Ev3: get lost
Ev4: get hurt
Ev5: mechanical problem

Relations: object-object

location (paper based info, rider/bicycle)
location (accessories, rider/bicycle)
location (sign, road)

Relations: action-object

patient (R1/L1, road)
- ride road
instrument (R1/L1, bicycle)
- ride using bicycle
instrument (L8, information sources)
- research route using information sources
instrument (R5/L5, paper based info/sign)
- follow the route using the paper based info/sign

Relations: action-event

while (R4/L4, R1/L1)
- read map while ride
before (L8, L9)
- research route before prepare a map of the route
before (L9, L10)
- prepare a map of the route
before advertise the ride in the SBL magazine or website
before (R2/L2, R3/L3)
- look for the ride in the SBL magazine or website
before meet at starting point
before (L11/L12/L13/L14, R1/L1)
- give a copy of the map to the other riders,
explain the route and the important points of interest,
give a safety briefing,
and specify the place to meet for lunch or to take a break
before ride
before (R4/L4, R5/L5)
- read map before follow the route
before (R6/L6, R7/L7)
- look for points of interest before stop
triggers (Ev1, R6/L6)
- when inclement weather, look for points of interest

triggers (Ev2, R6/L6)

- when nightfall, look for points of interest

triggers (Ev3, R4/L4)

- when get lost, read map

triggers (Ev4, R6/L6)

- when injury, look for points of interest

triggers (Ev5, R6/L6)

- when mechanical problem, look for points of interest

Analysis of the Existing System

An analysis of the existing system, automated or manual, including its strong points and deficiencies

The existing system is essentially manual.

The ride leader is responsible for defining the starting place for a ride, the routes to take and the places to stop. The information for a new ride comes from:

- previous knowledge
- a city or regional map
- riding the potential routes (by bike or in a car)
- asking fellow riders
- looking up rides in books and the internet

The ride leader draws a simplified map by hand, either freehand, or tracing over an existing map, or generating a simplistic map using mapping software. The route is then traced and annotated on the map. It is essential that the resulting route map show only as much data as is needed for the ride, as any additional info will require the riders to stop to reference the map more closely. Please see figure 3 for an example of a map.

Many ride leaders will also (or only) create a cue sheet, which lists each leg of the route, the distance of the leg, and where to turn. Please see figure 4 for an example of a cue sheet.

Hard Labor Ramble. 9:00 am ([3E](#)) Moderate

Join Athens Nitty Gritty Bike Band for a moderate paced ride. Map features various distances from 20 to 42 miles on rural roads, but there are many options to add distance if you wish to go further. Longer options include a store stop at Good Hope. Leave from Hard Labor Creek State Park. From Atlanta, take I-20 to the Rutledge Exit (105) and head north. Follow the signs to Hard Labor Creek State Park north of town. There is a \$2 fee to park. For more information, visit our website [Nitty Gritty Bike Band](#), or contact [Mark Dodson](#) or call 706-227-0774.

Figure 2. *Example of an ad in SBL's magazine placed by a ride leader*

Strong Points

The existing solution is essentially low-tech, and will work even without:

- Batteries
- PC and mapping software
- Bicycle mounted device
- Technical sophistication
- Knowledge of an interface

The existing solution also allows riders to:

- Tap into the expertise of a ride leader
- Get together with riding buddies

Deficiencies

Unless a rider already knows the route very well, or stays with another rider who does, the following problems can (and do) occur while riding:

- The information provided (map and/or cue sheet) is limited to the route(s) defined by the ride leader, and provides little or no information about anything outside of the route itself. If only a cue sheet is provided, there is no awareness of location with respect to the starting (and ending) point.
- Riders must actively look at the map and/or cue sheet in order to determine where to turn (and when not to turn) in order to follow the route. If a glance will not suffice, the rider must stop to take a closer look.
- Riders who veer from the route (take a wrong turn, or fail to take a turn) can find themselves quite lost, with only their memory of where they came from, in order to return to the route.
- Riders only know about a limited number of places to stop along the route based on information provided by the ride leader. If their need(s) are not satisfied by the information provided, they will have to discover it by other means.
- A rider who does not want to continue on a ride has little or no information regarding alternate routes.

While the above are issues that affect the rider while on the ride, there are other problems with the whole system:

- Riders are dependent on a ride leader to scope out and define a set of route(s), unless they want to invest significant time exploring on their own.
- There is no guarantee that the information provided by the ride leader is accurate, or that there are no changes in roads and/or road conditions.
- A rider must adhere to the chosen day and time in order to participate in a ride.

WILSON 100

Southern Bicycle League

2003

30 mile - 50 mile - 60 mile - 100 mile Options
(all distances are approximate)

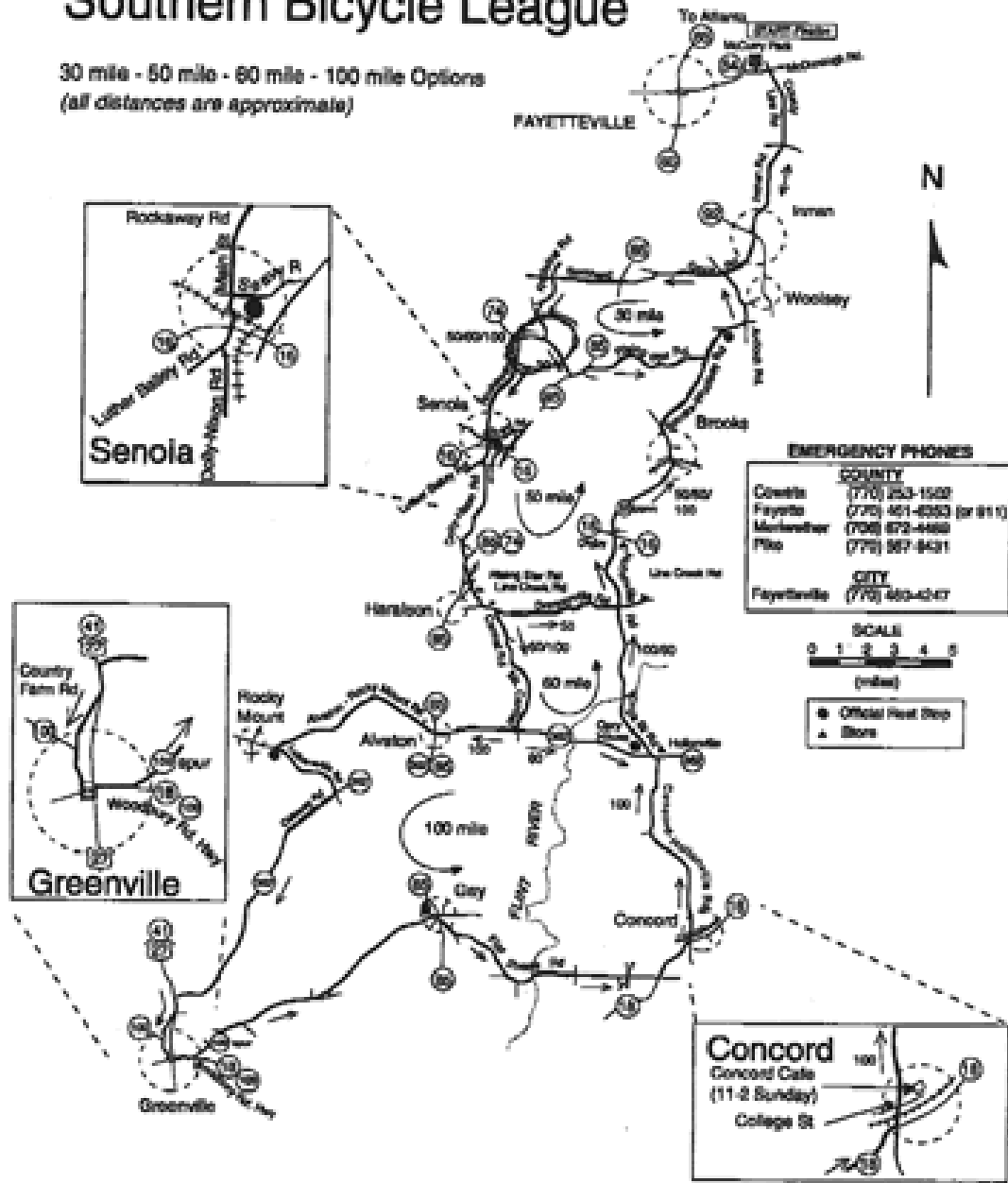


Figure 3 An example of a map for a rider

Between the Rivers (31 / 39 mi)

0.0	R	Business Rt 29
1.1	L	673 after crossing river
3.2	R	674 Kelly's Ford Rd
4.9	L	678 just before RR tracks
5.1	R	676 at stop sign
5.2	X	Rt 15/29 Use caution!
5.4	L	685
7.7	L	Alanthus Rd
7.8	X	Rt 15/29 Use caution!
7.9	L	762 at T
8.0	R	Carrico Mills
8.1	R	700, Mt. Dumpling Rd
	TRO	663 past numerous junctions until
12.5	X	Rt 3 Use caution!
15.4	L	647 at T in Batna
19.3	R	Rt 3 at stop sign
19.4	L	647 immediate left
19.5	X	Rt 3 "autobahn"
20.3	R	610
20.8	L	620 towards Edwards Shop
22.5		Store (stop?)
	TRO	620
		Stop at Inn at Kelly's Ford?
26.2	R	Over Kelly's Ford bridge
26.6	L	651 at T
31.0	X	RR tracks (possible extra miles*)
31.1	R	Franklin St
31.3	L	Bowen St
31.5	R	Business Rt 29
31.6	L	Into school
Extra miles*		
31.0	R	655 just before RR tracks
31.3	L	Lucky Hill at T
34.5	L	Bealton at T
34.6	R	Lucky Hill
35.6	L	VA 28 at T
	X	15/29 at light onto Kingshill 657
36.8	L	Cemetery Rd 658
37.9	L	Freemans Ford 651 at T
	X	15/29 Caution!
38.4	L	Business Rt 29
38.7	L	Into school

Figure 4. *An example of a cue sheet for a ride*

Larger Social and Technical System

A description of the larger social and technical system in which the design will interact

Our target users are the members of the Southern Bicycle League. They are interested in one or more of the following:

- Bicycle touring in the metro Atlanta area
- Learn more about cycling
- Socializing and camaraderie with other riders
- Cycling advocacy in the Atlanta area

There is an established relationship between the riders, the volunteer ride leaders, and the club. The club is also involved with cycling advocacy groups and therefore with local and state government. Our design is intended to provide riders with increased safety while riding, as well as more independence to pick and choose their routes and times to ride.

A cyclist, particularly a beginner, may be uncomfortable with the current system of group rides, maps, and cue sheets. Our design will allow them to feel more in control. This should have the effect of promoting more cycling in general. It may even encourage more cyclists to join a club in order to get the added benefits of camaraderie and advocacy. At the same time, some riders may decide that the independence afforded by our design allows him/her to go it alone. This may have the effect of reducing club membership.

Regardless of the immediate effect on individual riders and the clubs, the net effect of our design will be to promote more cycling. This will have the effect improved health through exercise, and additional uses of the bicycle as transportation.

One of the requirements for road touring is ... a road. Bicycle paths are a necessary component for riding in the city, and where they don't exist, cycling is a riskier proposition. As mentioned above, there are advocacy groups (like Atlanta's Path Foundation - <http://www.pathfoundation.org/>) that promote cycling and the creation and maintenance of more bike paths.

Though bicycles today are the result of advanced technology, as far as electronics are concerned, cycling is still a low-tech sport. Even so, many cyclists today use a "bicycle computer" to keep track of speed, distance and other statistics. Our interviews indicate that riders tend to be sophisticated, and are generally familiar with computers, but they also follow the KISS principle (Keep It Simple, Stupid). They may decide that one more device which can break down while riding is not acceptable, and thus not desirable.

In designing our system we need to be concerned with:

- Weight – will add more weight that needs to be carried
- Size – must fit on the bicycle
- Power requirements – must be battery operated, must work all day

Our design would have to work under extreme external conditions including:

- Extreme temperatures
- Rain and humidity
- Variations in ambient light
- Vibration

Our design will need to accommodate the clothing that riders wear. In particular, a rider may wear glasses (sun or otherwise), and must be able to see the display under variable light conditions. A rider wearing gloves must still be able to interact with the system while riding. All of this must be possible while still maintaining rider safety.

Electronic mapping and tracking technologies, and their associated databases, play an important part in our design. While there is a wealth of mapping services and databases, some work is required to tap into the data for use with our design, and the accuracy and existence of electronic maps is therefore a concern. We will also need to incorporate map storing, display and tracking functions into our design. GPS is the most prevalent technology used for tracking, but requires line-of-sight to multiple satellites, and accuracy can vary from several yards up to several hundred yards.

As in many aspects in our society today, the Internet will play a role in the design of our system. It will facilitate:

- Gathering information regarding routes and destinations
- Sharing ride information with other users
- Downloading software and data required for operation of the system

Usability Criteria

An initial list of usability criteria, or principals, that should be used in the eventual evaluation of the design

Riders spend their time on a rider for many purposes, including exercise, enjoyment, and socializing. Many users do not want to have to be working with a device which is distracting, complicated, or useless. If the device is any of these, it will serve as a hindrance to the rider.

Based on the requirements of the users, there are four main criteria for the system:

- Responsiveness
- Dialog Initiative
- Task Conformance
- Task Migratability

Responsiveness

“How the user perceives the rate of communication with the system.” (DFAB, 172)

- Responsiveness is one of the most important usability factors for our device.
- Bicycle can keep their eyes on a map for 2-3 seconds.
- The time that a user can divert their attention from the road is very limited
- In critical activities, such as map viewing and movement modes, the system must provide an “immediate” response.
- If the system is unable to respond within a “safe” time, then it should indicate it has received the user’s input, and inform the rider that they will be alerted once the task is complete.
- Similar tasks should carry a similar response, thus providing a sense of consistency and the feeling of stability.
- In order to determine the “safe” response times we plan to do a series of experiments with potential users.
- Once we have the empirical data regarding response times, we will then test and adjust the system to make sure it conforms to our criteria for safety and responsiveness.

Task migratability

“The ability to pass control for the execution of a given task so that it becomes either internalized by the user or system or shared between them.” (DFAB, 168)

- Allowing for task migratability is essential when dealing in the areas of maps and directions.
- Road maps are not always 100% accurate, roads may be closed or under construction, or a major accident may slow down traffic to the point where the ride is no longer enjoyable.
- The user will need to interact with the interface to possibly set new coordinates, find alternate routes, or to make changes.
- To test for task migratability, observations can be performed on the user interacting with the device. Given a certain task, we can attempt to determine that the task can be done by the user, by the system, and by a combination of both.

Dialog initiative

“Allowing the user freedom from artificial constraints on the input dialog imposed by the system.” (DFAB, 168)

- In most parts, the system should be user pre-emptive.

- It could be dangerous if the system tells the user to start an interaction with it, because this could cause a distraction.
- There are some critical situations when a system pre-emptive dialog is necessary, e.g. the user is about to miss a turn, get off the route or run the risk of missing a waypoint.
- The change between system pre-emptive dialogs and user pre-emptive dialogs could be context specific, i.e. dependent on the difficulty of the other tasks the user has to perform.
- Dialog initiative can be evaluated by observing and interviewing the user.
- If he/she loses track of the tasks that have been initiated and not yet completed too often, our system should be more system pre-emptive.

If the user thinks that there are too many system pre-emptive dialogs and he/she feels able to keep track of more tasks, there should be more user pre-emptive dialogs.