IPRO 308 Final Report

1. Executive Summary

Currently, some motorcycles have the ability to collect information about the performance of the vehicle. However, this information may not be easily accessible to the rider or mechanic of the bike and may also not be presented in an easily understood format. The equipment used to gather this data is generally not inexpensive as well. IPRO 308 intends to develop an affordable device called motoPro which firstly, will gather and record important information during a motorcycle trip and secondly, display that data in a user-friendly, understandable format. This data can be described as a rider profile. The rider profile will not only be useful for improving the safety and performance of the rider, but will also benefit the mechanic and also possibly the manufacturer of the motorcycle.

Team motoPro completed initial technological and consumer research during this 2011 summer semester. The team investigated current technology to see what solutions it may provide, began obtaining some hardware components for prototype research and also began interviewing members of the motorcycle community in order to gain valuable insights to use for the device. Some members of the team also completed the Basic Riding Course offered through the Motorcycle Safety Foundation in order to become more familiar with riding a motorcycle.

The project will continue into the 2011 fall semester and the team will continue consumer and technology research, create a compelling story with which to attract a sponsor and continue prototyping.

2. Purpose and Objectives

IPRO 308 aims to augment the motorcycle experience with MotoPRO, a device being developed which will create a rider profile using information gathered by sensors placed on the bike. This profile gives the rider useful data about their performance which can be used to correct poor riding habits or even just for fun. Being a better, safer rider will enhance the overall riding experience.

3. Organization and Approach

A. Customer Info

As of 2007, the National Highway Traffic Safety Association reported over 7 million registered motorcycles, a number which continues to grow steadily every year. These 7 million motorcyclists make up an extremely diverse community which includes many sub-cultures: leisure riders, commuters, track racers, etc. These subcultures differ in many ways but they all share a commonality; the joy of motorcycling.

Motorcycling provides a unique experience, allowing the rider to enjoy being on the road without the confines of a steel cage. It requires the full focus of the rider and gives a sense of freedom many may not find in their sedans and minivans. The motorcycle is not just a form of transportation, but a way of life.

B. Problem

Currently, just as in automobiles, there is a large variety of technology available for motorcycles. Some of the higher end motorcycles have computers and controllers that control the operation of the motorcycle and collect information while lower end motorcycles have little to no computer technology. Motorcyclists and technicians each have access to partial information about the performance of the motorcycle. The information that is available to the rider is very limited and often not easily accessible due to the dashboard user interface. The proposed system would download information from the motorcycle in the aforementioned two modes, one for the motorcyclist and one for the technician and with the owner's consent provide data to the manufacturer.

C. Current Technology

Current technology already allows for the specific riding data intended for users of the motoPRO, such as tire pressure, tire temperature, etc. However, it is generally expensive and is only available from certain high-end manufacturers or for precision race and track riding. There is also not an inexpensive product which gives access to all of these parameters.

D. Previous Solutions

Some of the tech we're considering has already been successfully implemented by a few bike manufacturers, but we intend to bring it to the mainstream consumer. Other tech is available in cars but not motorcycles.

E. Ethical Issues

One feature of the device in consideration is to have data collected from a rider sent directly to the manufacturer for product development purposes. Another consideration is that the data could be accessible through online sources. These features bring to light privacy issues. Developing a data portal which ensures privacy would be essential.

Another issue raised by providing such data is safety. One of the existing purposes in collecting performance data is to improve lap times; in other words to go faster. It is unavoidable that people will sometimes ignore speed regulations. Is it ethical to provide a device which may tempt users to push their motorcycle to the limit, therefore breaking the law and possibly injuring their self? These and other unrealized ethical issues must be considered throughout the development of the motoPRO device.

F. Societal/Business Costs and Benefits

Since current rider performance data is not easily accessible or inexpensive, many motorcyclists may not be aware of poor safety or riding performance. This remains an issue as motorcycle accidents have much graver outcomes than typical automobile ones. An automobile driver involved in an accident

has more protection than a motorcyclist; seatbelts, airbags, a steel frame surrounding them. A motorcyclist has only protective gear such as pads and a helmet and is much more likely to be seriously injured or killed by a collision. By providing data which may improve safety and riding skill, accident and injuries can be avoided.

The motoPRO device will also indicate when an impending equipment failure will occur. This will enable motorcycle owners to replace worn brakes, fill tires and other maintenance requirements, further lessening the likely hood of accidents. This feature will also help improve the lifespan of a motorcycle and decrease costs for the owner. A properly maintained bike will run better and will require less repair costs.

The motoPRO will not only improve the quality of the motorcycle experience for riders, but will also be extremely lucrative for the manufacturer of motorcycles. Providing the information collected to manufacturers will enable them to diagnose and improve their products. Manufacturers would be able to evolve their manufacturing processes to help bring about the next generation of safer, more efficient and user-friendly motorcycles as well as assistance devices. The system will also give manufacturers an edge in the industry by tapping into an under-utilized user interaction.

G. Proposed Implementation Outline

After testing several components and deciding which functions will be most appropriate to monitor, we will put together a detailed proposal of what our product will do and how it will add safety and enhance the experience for the rider. Our product will provide critical data for the technicians performing maintenance on the motorcycle as well as provide valuable feedback to the designers as to heading off any critical issues which may be addressed during the design phase.

The major goals for this first semester included:

- Research what we're doing and decide on scope of product
- Identify potential users, vendors and compatible bikes
- Contact motorcycling community and determine user needs

- Find sponsor(s) [bike manufacturer/accessory maker] and understand their requirements
- Collect and assemble parts
- Initial field testing

Solutions will be developed with the collaboration of the motorcycling community at large. Data collected from the community will be compiled and analyzed, possibly with the help of an online database which riders can access directly. Once the needs and wants of the community have been assessed, more in depth work on a prototype may begin including sponsorship and hardware research.

The project will also involve some initial field work; obtaining some test sensors to begin assessing the feasibility of a prototype. This work will most likely be very informal and also serves to give the team more experience with actual motorcycles.

B. Team Structure

We have chosen to divide into fluid teams as the task demands. Our group is small enough to work as a whole, and sub-divide to handle smaller tasks as needed. With only 7 members on the team, we expect few issues involving organizing and assigning tasks. Everyone is able to contact and interact directly with every other member.

4. Analysis and Findings

Our pool of interviewees ranged from experienced motorcycle riders (the vast majority) to a Garmin store manager who did not ride at all. The span of their experience with motorcycles ranged from 2 - 40 years.

Among the eight experienced motorcycle riders, two were active or retired motorcycle police officers, one a motorcycle training instructor and two part- or full-time mechanics; six among the pool described themselves as casual riders. All of them had street bike experience. In particular, two of the

interviewees ride Harley Davidson motorcycles and another rides a racing bike. (Police motorcycles are identified here as street bikes/cruisers).

Motorcycle Data Sensors:

Nearly every interviewee showed interest in tire pressure sensors; other candidates suggested by interviewees included, but were not limited to: chain tension, temperature of tire, engine, electronic parts, brake life, fire plug status, lean angle, and fuel consumption status. Some interviewees, however, were not as interested in some of the features under consideration, such as lean angle and GPS navigation.

Motorcycle Training:

Chicago Police Department Motorcycle Unit officers described a lack of training as the one of top two reasons responsible for most motorcycle accidents. An instructor for the Ride Chicago Motorcycle Training School also stated the belief that in most cases, accidents are caused by insufficient training. A common pattern we detected over the course of our interviews is that most training—if conducted at all—ends at the stage of the process when an official motorcycle license is approved; the weight of opinion seemed to suggest that such training should continue well into the rider's future and be repeated an reinforced with supplemental lessons in a timely manner.

5. Conclusions and Recommendations

While IPRO 308 has not conducted enough research for statistical analysis, valuable insights have been gathered from interviewing riders and other people connected to the motorcycling community. Firstly, the motorcycling community seems to be very friendly and open to communication. Future interactions will yield continued support and enthusiasm for the project. The community also seems open to the idea of a product such as motoPRO.

Through interviews and tech research, the team has discovered several electronic sensing metrics that are likely candidates for the motoPro suite, namely tire pressure, tire temperature, lean angle and brake sensing. Through these elements, a rider profile can be created.

Although the elements of the rider profile are already available through existing technology, they are not necessarily presented in a useful context. The rider profile will remedy this through being user-friendly and easy to understand.

The team has also learned that there is no substitute for practice when it comes to improving motorcycling skills. motoPro will not automatically improve riders, but will allow them to observe their own habits and riding performance via the rider profile so that they may improve them, thus improving the riding experience altogether.

IPRO 308 still has lots of work to complete in the upcoming semesters and several key positions have been identified as necessary for the future. Electrical and computer engineers will be needed, along with mechanical engineers and computer science majors to integrate the physical prototype and the programming necessary for the device. Along these lines, business majors along with more design-oriented students will be required for creating a captivating story for the purpose of garnering interest in the project and achieving a sponsorship.

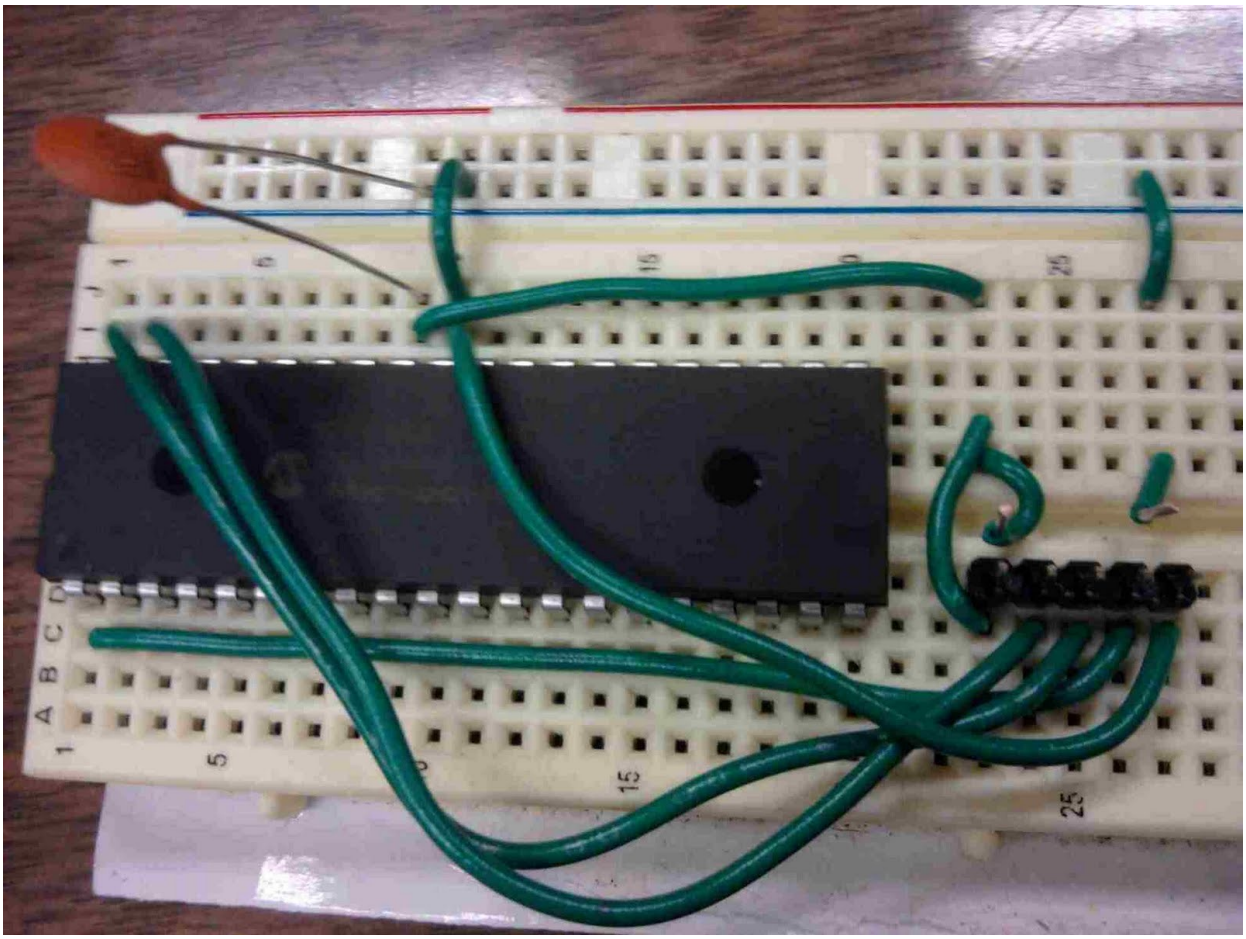
motoPRO is currently in the early stages of development and many man-hours and inter-professional insights are required before achieving success. Customer and market research, sponsorship, electrical, mechanical and computer design as well as programming are all essential facets of the motoPRO development structure. IPRO 308's team members can enjoy the experience of technical and professional development as well as gain insight into the motorcycling lifestyle by completing the Basic Rider Course, provided through the Motorcycle Safety Foundation. With your help, motoPRO promises to be an innovative, challenging project which will greatly enhance its participants, as well as the overall motorcycle experience.

6. Appendix

Prototype Report

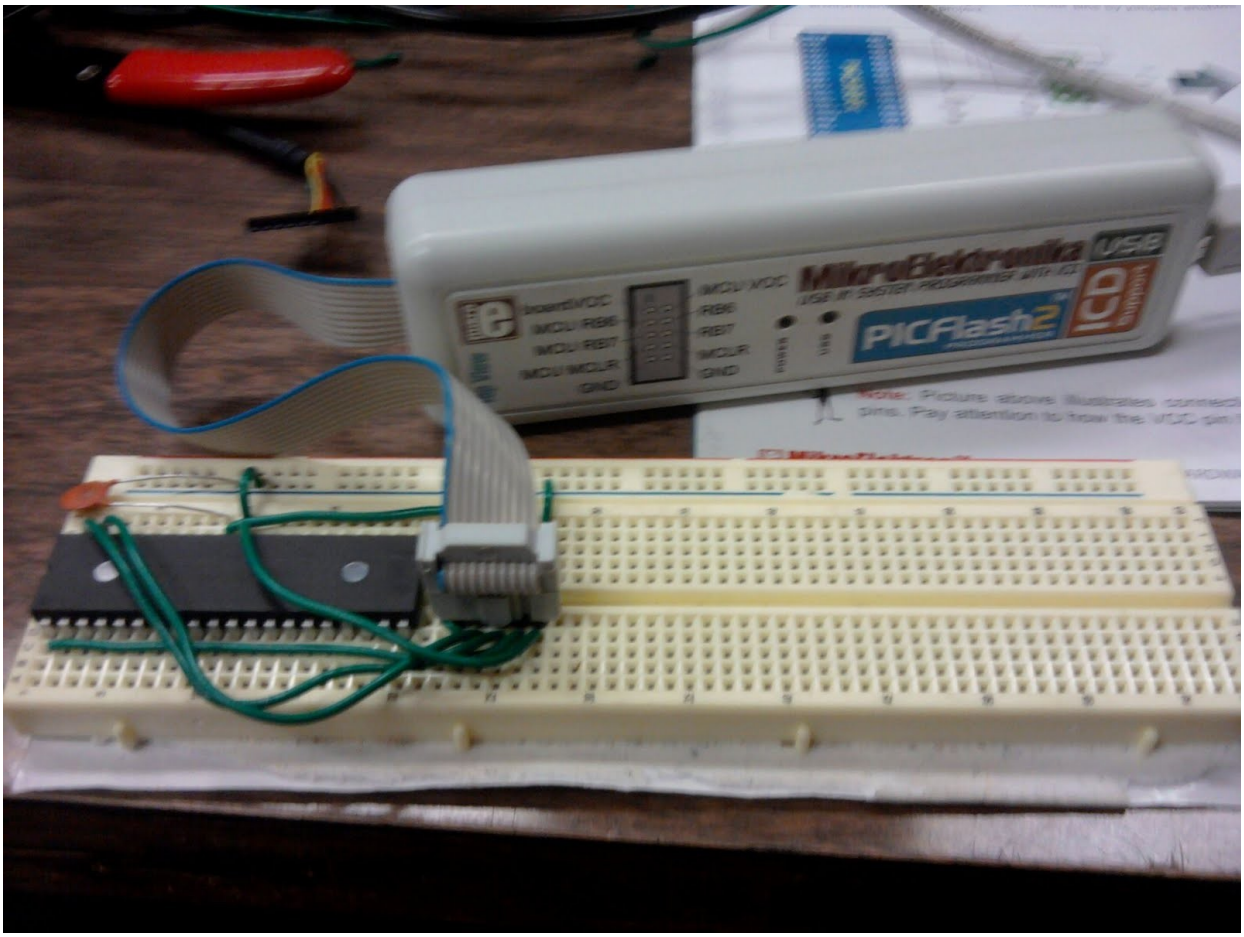
From the beginning of this project there has been a lot of assistance from Illinois Tech Robotics. Some hardware we were allowed to use included a breadboard and a PIC Programmer. These are things that future IPROs will either need to purchase or continue to work with Illinois Tech Robotics in their lab.

When re-assembling the breadboard the wire layout is as shown:



When programming the PIC, two (free) programs are needed, PICflash from Mikroelektronika (manual can be found here: http://www.mikroe.com/pdf/easypic6/picflash_manual_v101.pdf), and MPLab from Microchip. MPLab is used to code in C and compile your programs, PICflash is used to load the

compiled file onto the PIC and it uses the programmer as shown:



Currently there is no code for the program itself and the gyro/accelerometer has yet to be integrated with the PIC, as soon as code can begin to be run on the chip then that is the next task.

References:

IDOT Motorcycle Instruction Attendance Information
http://www.mrp.uiuc.edu/attend.aspx

Chicago motorcycle guide used to schedule interviews
http://www.chicagomotorcycleguide.com/

Riders for Health—an organization the motoPRO device can aid
http://www.riders.org/us/how_we_work_trm.aspx

Types of sensors ordered to assemble prototype:
infrared thermometer
http://www.webbikeworld.com/r2/digital-infrared-thermometer/digital-infrared-thermometer.htm

Integrated Gyro/Accelerometer Board
http://www.bostonandroid.com/DAUGHT-GYRO.html

Continental Sensorbox—a device similar in scope to motoPRO's gyro/accelerometer component
http://www.conti-online.com/generator/www/de/en/continental/automotive/themes/two_wheelers/sensorbox_en.html