MAE 476/576 Mechatronics

Mini-Assignment 1

Theme: Integration of Ubiquitous Computing, Communication, Sensing & Actuation

PART 2

Keyless Entry System
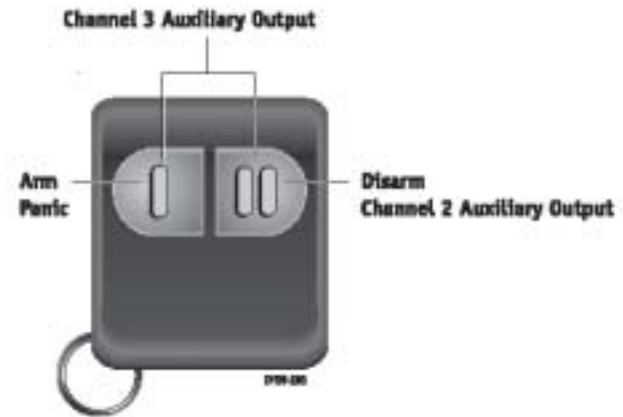
This system integrates

Computing

Sensing

Communicating

Functions:

➢ Arming

➢ Disarming

➢ Disabling and Re-enabling the Back-up Siren

➢ Panic Mode

➢ Valet Mode

➢ Diagnostics

   1. Arming

   2. Disarming

Special Features
CONTROL UNIT:
It houses the microprocessor which monitors and controls all of the system's function
TRANSMITTER FUNCTION:
The receiver uses a computer based learn route to learn the transmitter button. This makes it possible to assign different Transmitter button to different receiver functions.
NUISANCE PREVENTION CIRCUITRY
It prevents repetitive trigger sequences due to faulty sensors
RAPID RESUME LOGIC :
IT stores the current state in non-volatile memory.
HIGH FREQUENCY :
Provides a cleaner spectrum with less interference and a more stable signal.
POWER SAVER MODE :
Helps to lower the current draw on the vehicle's battery and prevents the system from draining the battery.
SECURITY AND CONVENIENCE OPTION :
Back up Battery
Head Light and Parking Light Automation
SHOCK SENSOR :
It is designed to detect impact to vehicle
FAILSAFE STARTER KILL :
It prevents the system from cranking whenever the system is armed
Relevant Links:
http://www.directed.com/guides/manuals/og/viper/122V.pdf

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Blendtec BD-8 Blender

http://www.selectappliance.com/exec/ce-product/bt_bd-8

Mathe, Garth

Features

- 3 1/2 peak horsepower microprocessor controlled motor
- LCD panel for prompts, read outs, and diagnostics
- 32 recipe memory
- Precisely metered, external ingredients pumped to blender jar automatically

Mathe, Garth

Benefits of use in a Restaurant/Bar Setting

- No need to train bartenders, saves $ in labor

- Mix complicated drinks quickly, reduces customer waiting time

- Precision ingredient mixing controllability, more reliable than less precise bartenders

Mathe, Garth

William Mitchell

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MAE 476/576

Mechatronics

Microwaves have had many improvements and options in order to make them more "user friendly"

The main focus of these improvements have been to give the user more options in control, and make cooking different foods easy.

Many special buttons have been added to modern microwaves to allow "one touch" cooking. The microwave calculates how long the food will take to cook.

Mitchell, William

Sensor Cook

Just select the food category and press Start. The oven will detect the humidity rising from the food to calculate the ideal cooking time.

Auto Menus

Auto Cook allows you just select one of the pre-programmed menus, enter the weight and press start.

Easy Defrost

For true convenience in defrosting, you can simply enter the weight of the frozen food and leave the rest to the oven.

Convenience Meals Keys

Quick and easy one touch keys for Pasta and Frozen Dinner, makes cooking popular dishes even more convenient.

Mitchell, William

Air Bags

An air bag is an inflatable automobile safety device that helps protect a driver or a front-seat passenger in a head-on or front-angle collision
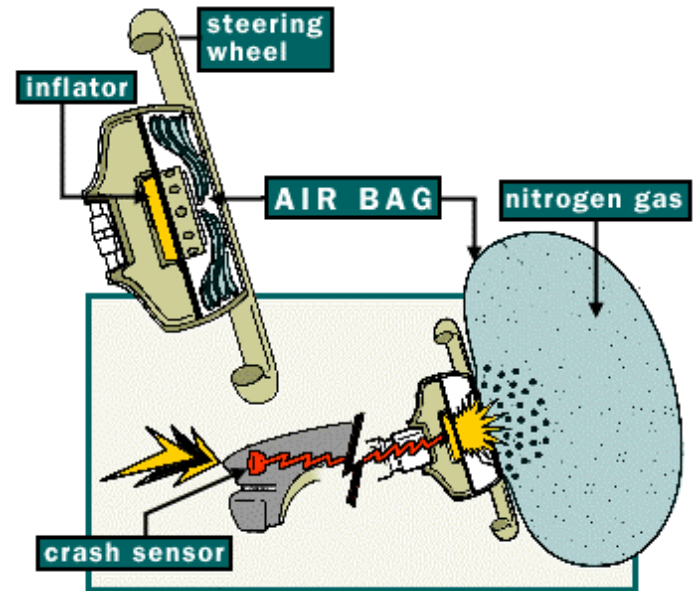
Sensors mounted in front of the car senses whether a crash occurred or not

Onboard computer computes whether to deploy the air bag or not an with what force.

The actuator(inflator, in this case) deploys the air bag with required speed/force

The air bags have become an essential safety feature in almost all the cars these days,saving lives or averting injuries of many people.

Initially air bags used to deploy with the slightest indication of crash,but now a days with advanced sensors and onboard computers they get deployed with different forces for different crash situations.

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Air Bags

Some of the related sites:

http://whyfiles.org/032air_bag/how_work.html

http://www.sensorsmag.com/articles/0999/97/main.shtml

http://www.nsc.org/public/air0801/12.pdf

http://members.aol.com/carleyware/library/airbag01.htm

http://www.sanjuan.edu/schools/arcade/AirbagCB.html

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Personal Robot System :ER-1
By Evolutionary Robotics.

Sameer S. Patwardhan

Functions and Capabilities.

- Gripper to carry and grip the objects.
- Can be used as a Trailer to move objects.
- Obstacle avoidance .
- Personal assistant with backpack.
- Can be used as a Mobile car like carrier.
- Applications like Tractor trailer
- Can be used as a Butlerbot for applications like fetching.
- Speaking capacity, personal photographer, reprogrammable and can be trained also.
- Can be trained to use home appliances like vacuum cleaner and kitchen appliances like oven.
- Object Recognition and voice command operated machine for multi-user operations.

Sameer S. Patwardhan

Links to the product

- Link to the different video demos of the robot. http://www.evolution.com/product/consumer/er1/video.masn

- Link to the different pictures of ER-1 http://www.evolution.com/product/consumer/er1/pictures.masn

- Different capabilities of ER-1

http://www.evolution.com/product/consumer/er1/25things.masn

Submitted by Sameer S. Patwardhan.

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Robotics

- Looks depend upon the application of the robot.
- Industrial use:
  - may have an arm attached with some type of claw
  - a train to move parts around a factory
- It also may have an LCD display and sensors for maneuverability

David Pericak

Robots in Industry

- Improve Performance:
  - The job will be done with more accuracy
- Costs of the enhancements:
  - The cost would be great because of the R&D needed to create the robots to implement in industry
- Enhancements would lower costs:
  - Once the robots are implemented into industry companies would not have to pay people to do the work that robots could do.
  - Robots could work longer without breaks and more efficiently

David Pericak

Smarty : Intelligent Interactive Doll

An intelligent interactive doll for children aged 3-6. Smarty™ doll introduces exciting new dimensions into the international toy market. It incorporates Ubiquitous computing , Communication and Sensory capabilities.
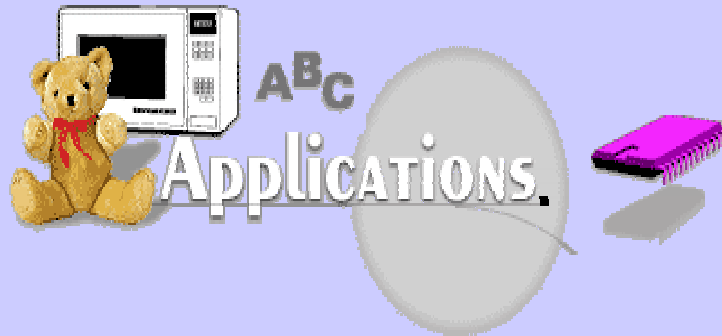
Features

❖ Artificial Intelligence

❖ Speech Recognition Abilities

❖ Sensors

❖ Human charactereristics

❖ Edu Tainment

Jairam Ramaswamy

➤ Incorporates advanced Artificial Intelligent Mechanisms which uses ASIC software as the basis for intelligent interactions which helps it to learn the child's character and its preferences like the child's favourite colours and gauging his level of intelligence.Smarty eventually adapts its own character to the child's character.This exposes the feature of Ubiquitous Computing and Communication features.

➤ Incoporate speech recognition abilities which help Smarty to first listen and understand the child's speech and responds specifically to the child's answers in the form of natural,free flowing life like conversations hence exposing the sensory capabilities which help it to do the required functionalities.

➤Incorporates sensors which help it to respond to the child's touch on its nose, hands and feet. The more sensory attention Smarty receives, the happier it gets.

➤Incorporates unique personality traits which include likes & dislikes, and ever-changing moods (happy, nasty, etc.). Its moods are influenced by the child's behavior (lack of response to Smarty's questions causes Smarty™ to turn grumpy).

Jairam Ramaswamy

➢ It plays educational games as well as games which are exclusively fun (sing-alongs, jokes, stories and riddles). Smarty can teach children a new language, math, vocabulary, basic facts and more - all in a fun, playful and informal manner. As the child's best friend, Smarty can be a most effective teacher, introducing learning as another kind of game.

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Relevant Links : http://www.smartoy.co.il/index.htm
                 http://www.smartoy.co.il/tools.htm

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MAE 476/576
Mechatronics

Casio Wrist - technology

The Casio WQV1-1 watch is a prime example of the integration of ubiquitous computing, communication and sensing.

The watch integrates a camera, an infrared port for uploading to a computer, software for image format conversion, a calendar, a databank and other "smart" features.

Key "smart" features

TECHNOLOGY
Images are picked up by a new ultra-small, low-power CMOS image sensor. A built-in infrared port allows exchange of images with another Wrist Camera or a computer.

- **1/14-inch Monochrome CMOS sensor**
- **Total Pixels:28,000; Pixel Yield: 24,334**
- **Lens: F2.8 Fixed; f=1.1mm**
- **Memory Capacity: Up to 100 Images**
- **Monitor: 120x120 dots(14,400); Monochrome with 16 Grayscales; 20x20mm Screen Size**
- **Recording Modes: Normal, Merge**
- **Databank: Up to 24 Character per Image**
- **Infrared Communication: Casio Original System**
- **Infrared Function: Image Data Exchange with a Computer, Data Exchange with another Wrist**
- **Data Speed: 115,200 bps**
- **Communication Distance: 10cm Maximum**

Features:

- **Recording Format: Casio Original (Conversation to BMP or JPEG when uploading to a computer)**
- **Recording Medium: Built-in 1 MB Memory**
- **Memory Capacity: Up to 100 Images**
- **Recording Element: 1/14-inch Monochrome CMOS sensor**
- **Total Pixels:28,000; Pixel Yield: 24,334**
- **Lens: F2.8 Fixed; f=1.1mm**
- **Focusing Distance: 30cm**
- **Subject Illumination: Approx. 100Lx to 45,000 Lx**
- **Exposure Control: Light Metering System: Full Screen Average: ALC(Average Luminance Cont.)**
- **Exposure Compensation**
- **Shutter: Electronic Shutter**
- **Shutter Speed: 1/11 to 1/1600 second**
- **Monitor: 120x120 dots(14,400); Monoch-rome with 16 Grayscales; 20x20mm Screen Size**
- **Recording Modes: Normal, Merge**

EASY OPERATION

Quick and easy image recording with the press of a button.

Vikranth B. Rao - 2827 1509

Features:

- **Databank: Up to 24 Character per Image**
- **Infrared Communication: Casio Original System**
- **Infrared Function: Image Data Exchange with a Computer, Data Exchange with another Wrist**
- **Data Speed: 115,200 bps**
- **Communication Distance: 10cm Maximum**
- **Countdown Alarm:**
- **1 Minute to 60 Minutes**
- **Unit: 1 Minute**
- **Low Battery Warning**
- **daily Alarm**
- **Auto-calendar (pre-programmed until the Year 2039)**
- **Size of Case/Total Weight**
- **1/100 Second Stopwatch**
- **Measuring Capacity:23:59'59.99"**
- **Auto Power Save System**
- **12/24 Hour Formats**
- **Hourly Time Signal**
- **Regular Timekeeping (hour, minute, second, pm, year, month, date, day)**
- **Accuracy: ±15 seconds per month**

The Optical Mouse

Assignment 1

Uma Shankar Sharma

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- Developed by Agilent Technologies is a perfect example of Mechatronics application integrating Ubiquitous Computing, Communication, Sensing and Actuation

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- It has a red light emitting diode that bounces light off from surface onto a CMOS sensor

- The CMOS sensor sends each image to a digital signal processor (DSP) for analysis

Button
USB Connector
Camera IC
Mirror & Lens
LED
Controller IC
Clock X-tal
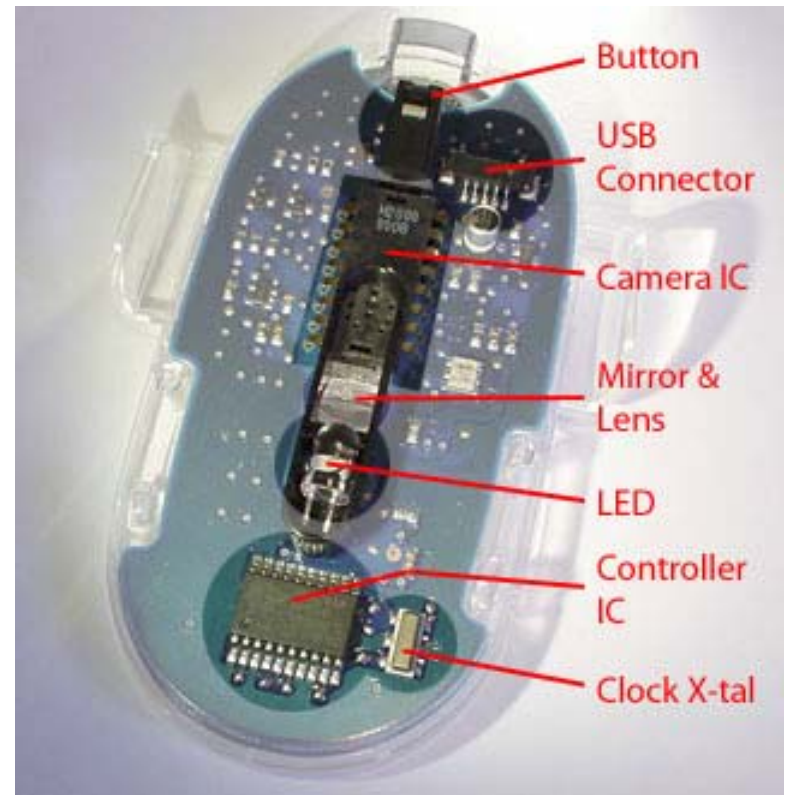
- The DSP, operating at 18 MIPS (million instructions per second), is able to detect patterns in the images and see how those patterns have moved since the previous image

- Based on the change in patterns over a sequence of images, the DSP determines how far the mouse has moved and sends the corresponding coordinates to the computer

- The computer moves the cursor on the screen based on the coordinates received from the mouse. This happens hundreds of times each second, making the cursor appear to move very smoothly.

The Lens

Camera Chip Opening

Uma Shankar Sharma
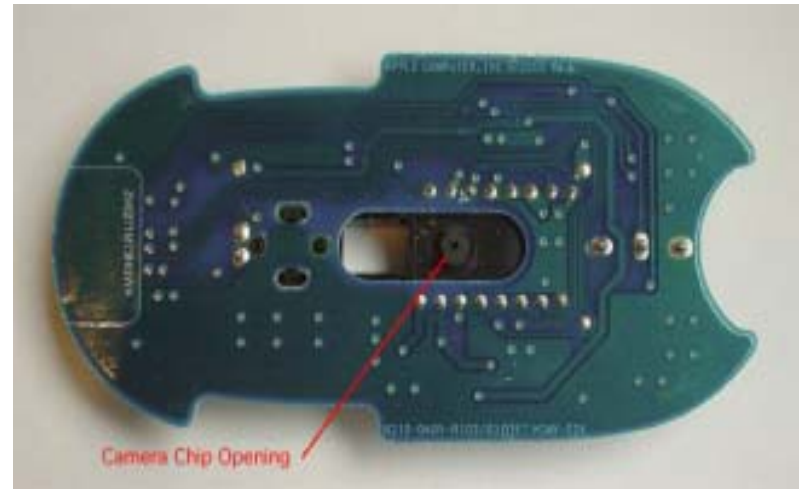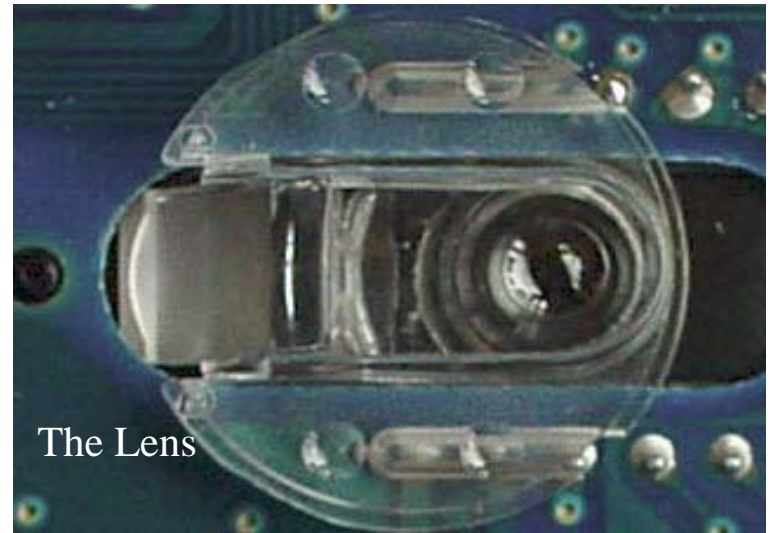
Advantages

- No moving parts which makes it less prone to wear and hence a lower chance of failure
- Tracking resolution is increased which makes it work smoother
- There's no way for dirt to get inside which could interfere with the tracking sensors
- They don't require a special surface, such as a mouse pad

References:

1.   http://www.chipmunk.nl/ProMouse

2.   http://www.microsoft.com

3.   http://www.howstuffworks.com/first-time.htm

Uma Shankar Sharma

MAE576 Mini Assignment-I

*Smart*Window Non-Contact Window
Management System

By

Gopikrishnan Sidhardhan

*Smart*Window Non-Contact Window Management System

- Product of Delphi Mechatronic Systems (http://www.delphi.com/pdf/mechatronics/SmartWindow.pdf).

- Used to detect obstacles in the path of automobile power-windows.

- Incorporates all of Ubiquitous computing, communication, sensing and actuation.

Sensing:

- Uses an infra-red sensor to detect obstacles as small as 4mm. in the path of the closing window.

Communication:

- On detecting an obstacle, a signal is sent to the controller within 25 micro-seconds.

Computing:

- The correct or obstacle-free path of the window pane can be programmed into the controller.

Actuation:

- On detecting an obstacle, the controller stops or reverses the window immediately.

Advantages over conventional systems of similar functionality:

- The programmability of the system gives additional flexibility to the OEM customers, i.e., the vehicle manufacturers.

- Unlike conventional systems, the *SmartWindow* system detects obstacles before coming into contact with them.

- Integrates easily into existing door mechanisms, unlike conventional systems which may need special seals and other mechanisms.

- The *SmartWindow* system is customizable to OEM specifications.

MAE 576

MECHATRONICS

Bar Code Readers

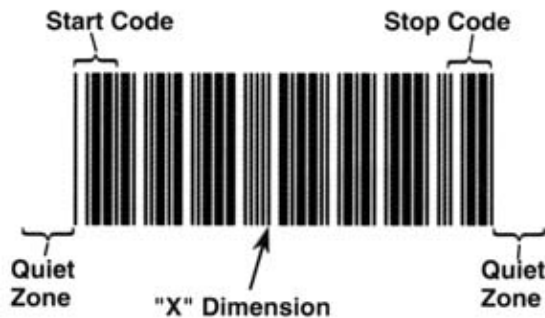*Integration of ubiquitous computing, communication, sensing and actuation*

Srinivas Sundaragopal   ss258@buffalo.edu   http://buffalo.edu/~ss258

Assignment 1

What is Barcode Reader

- Bar code - Encoding numbers and letters by using a combination of bars and spaces of varying widths, essentially a "look-up" number that corresponds to some descriptive data

- Becoming increasingly popular for its easiness in use and Point of Sale (POS), File Tracking, Asset Management and Market Research

- Newer technologies like laser, programmable bar code readers in the bar code front are testimony to its increased usage in the future

- Bar code data must be captured and decoded into a data format that the computer can process for further manipulation of data - this is done by a bar code reader

Why bar code readers

Statistics reveal

- Proven - bar codes have been around since the 1960s
- Used by millions of organizations world-wide.
- Basis of billions of transactions around the world each day
- Robust - equipment is designed for the workplace

Advantages

- Speed – 12 chr. barcode reading = 2 keystrokes
- Accuracy – Error rate: OCR - 1 in 10000 reads, Wands – 1 in 3,000,000, Laser 1 in 70 million
- Data Integrity
- Easy Implementation – Very less effort to train, cheap due to effective hardware/software implementation
- Cost Effective – Pay back period is from 6 to 18 months

Industry Standard Features

wireless

- Wireless operation of 30-40m approx. ▪ Up to 5 bar code scanners per base station ▪ Automatic trigger ▪ 30000 scans on one charge ▪ Powerlink user replaceable cables ▪ Firmware updates via Flash ROM ▪ Custom edit of bar code data RSS-14 decoding capability   http://www.iposltd.com/m9530ft.html link

programmable

- Programmable Bar Code Reader ▪ Plug and Play ▪ Software embedded, no additional software ▪ EAN13, Code39, Code 128 and Telepen compatible ▪ Has hands free, triggerless, prefixing, suffixing and data editing capability ▪ Fully Cross Platform Compliant Mac - PC ▪ Available with interfaces for USB, ADB, PS2 or PCAT   http://www.peninsula-group.com/barcodereader/Default.html link

pen

- Rugged type of reader ▪ Scanned data is fed into the system via the keyboard port ▪ Compact: All electronics housed in the main pen housing. No external interface boxes ▪ Optical bandpass and electrical factors ensure that it will read labels under sunlight or strong fluorescent light ▪ Powerful configurable features can be programmed   http://www.azio.co.uk/wa2380.htm link

laser

Handheld Laser Scanner ▪ 2 color indicative LED ▪ Superior depth of field ▪ Can read RSS bar code ▪ Aim and shoot design ▪ Adjustible beeper ▪ RS232, Keyboard Wedge, Wand Emulation, IBM 46XX and USB interfaces ▪ Advanced Data Formatting ▪ Flash memory ▪ Reduced Space Symbology (RSS) bar codes
http://www.barcodesinc.com/psc/qs7000-quickscan-7000.htm link

Further reading

Web links / references

- http://www.azalea.com/faq/FAQ.pdf ***
- http://www.barcoding.com/barcoding101.shtml ***
- http://www.semicron.com/scannertips.html **
- http://www.barcodeproducts.co.uk **
- http://www.barcode-qld.com.au/faq.htm *
- http://www.barcode.com/faqs.html *

Related Products

- Barcode reader
- Barcode software
- Barcode printer
- Barcode fonts

* Recommendation

Assignment: Integration of Ubiquitous computing, communication, sensing, and actuation.

Matthew Szymanski

MAE 576 (EngiNet)

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The Bicycle Computer
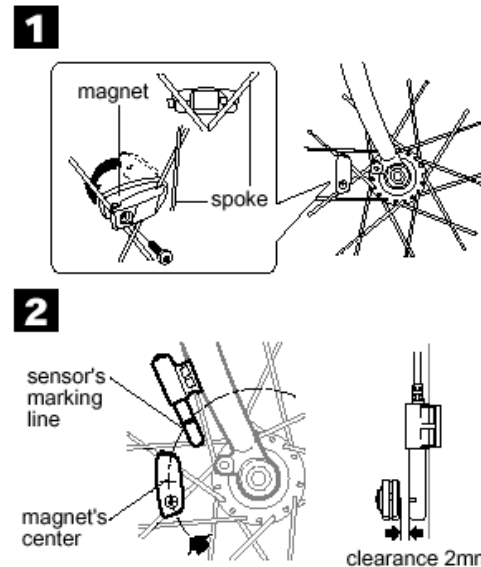
Consists of:

A Display/Processor

(on the handlebars)

Sensors

(on the wheels, pedals, and body)

and

For: Communication and Computation

For: Gathering data

The Bicycle Computer

- Allows the rider to keep track of:
  - Speed/Distance
  - Pedal RPM and Gear number
  - Elapsed trip time
  - Average Speed/RPM (excluding stops)
  - Max speed/RPM
  - Altitude
  - Heart rate
  - Programmable workouts
  - Multiple bike and wheel diameter setups
  - Maintenance schedules

- Manufacturers:
  - Cateye: http://www.cateye.com/gory2.php?cat=com
  - Shimano: http://bike.shimano.com/Computer/index.asp
  - Sigma Sport: http://www.sigmasport.com/index_usa.html

The Bicycle Computer

- Where can it go from here:

  Next generation bike computers could interface with GPS and weather satellites.

  - This way the computer could:

    - Select a route for you based on your heart rate and the terrain ahead.

    - Warn you of bad weather and tell you the fastest way home if it starts to rain.

    - Adjust resistance to wheels to vary your workout on level terrain.

Why not expand this to other forms of exercise?

- You could make a wearable computer for runners with sensors in sneakers to perform the same function as the bike computer.

OR

- Help skiers keep track of speed, snow conditions, friction, route down the mountain, etc.

Product Segment: Medical Appliances

Broadly classifying medical appliances to include:

1) Remote Surgical Applications.

2) Automated Products for the Disabled.

3) Remote Teaching Aids. (Medical School)

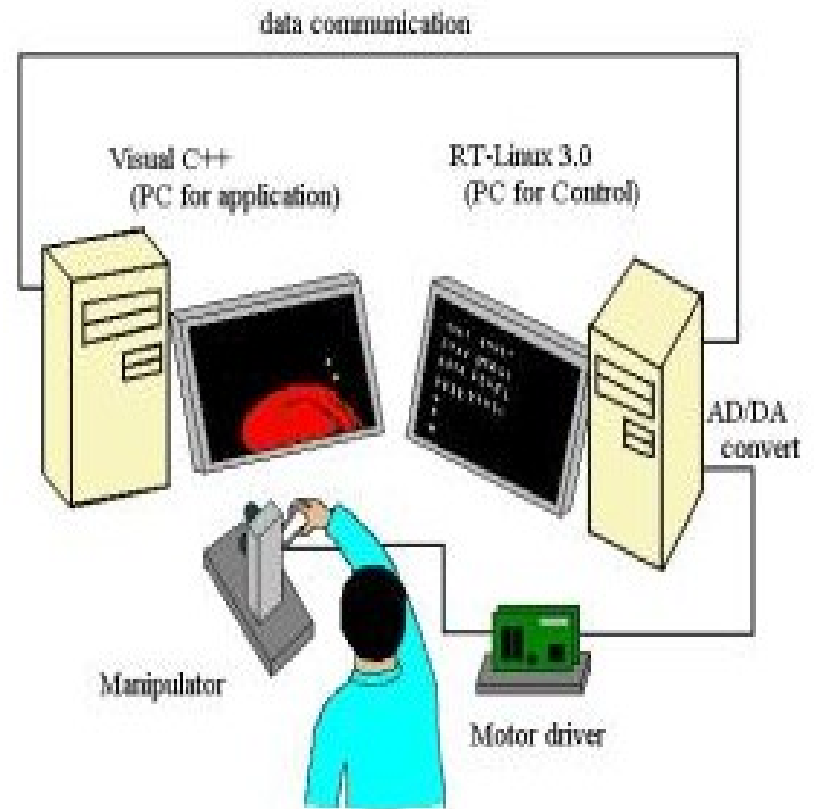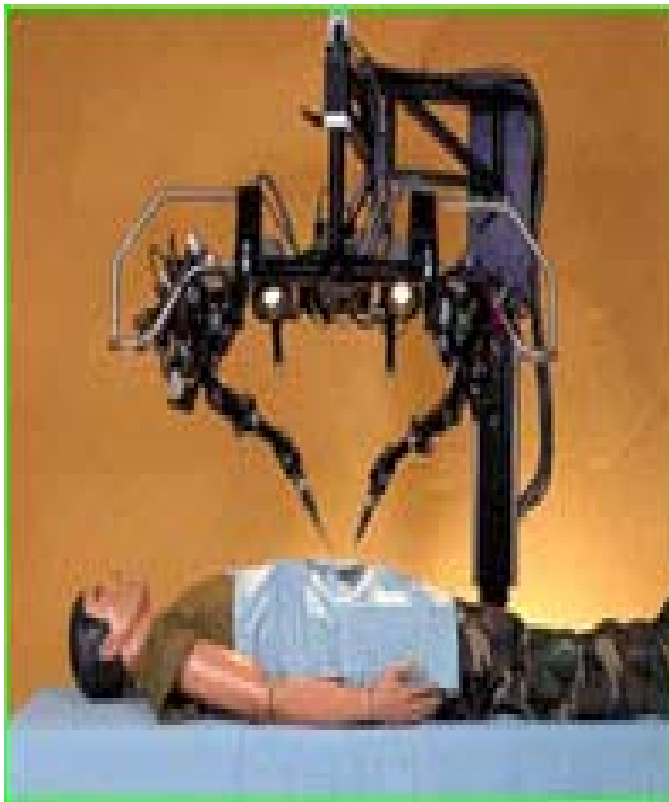4) Automated Medical / Rehabilitation Services. (Ex : Automated Medication Dispensing Devices)

Examples:

Automated Wheelchair:

Rohit R Thali

Remote Surgery
& Surgical Training

- Combination of Ubiquitous Computing, Communication, Sensing and Actuation.

Rohit R Thali

Summary:

- Medical Applications is an area that is accommodating new technology to provide enhanced services.

- Apart from providing better products for use in the medical arena and by people afflicted with health problems, disabilities, there is also the added goal / capability to support learning and transfer of expertise regardless of physical distances.

Relevant links

- **www.sri.com/ipet/tp2.jpg**
- http://citeseer.nj.nec.com/15478.html
- http://www.imcs.mse.kyutech.ac.jp/surgery/surgery.html
- http://www.ahcpr.gov/clinic/ptsafety/chap11.htm
- www.business2.com/articles/mag/0,1640,35201,FF.html

Rohit R Thali

Submitted by:

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Mechatronics Assignment 1

Functionality and Design of a mechatronic product incorporating Communication, Sensing and Actuation.

Product name: Fuel injection & Engine Control Unit.

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Gaurav Tyagi

Fuel Injection Pump and Engine Control Unit

- **Purpose of the Mechatronic System**

1. Ensure lowest emissions to meet the emission laws
2. Determining how long the fuel injection be open for fuel economy i.e. best mileage.
3. Modern ECU even fire spark plugs and controls the cooling fan.

Injection Pump

Gaurav Tyagi
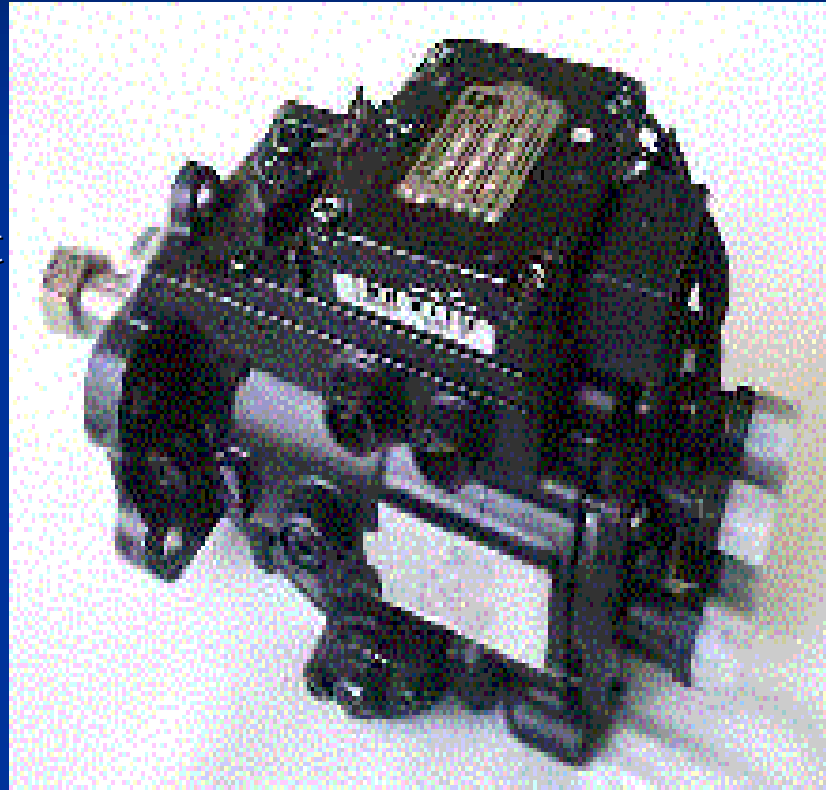
Working of the Mechatronic System

- ECU is installed in a sealed box that is mounted directly to the cylinder block of the engine

- ECU *communicates* with injection pump through high speed 2-way CAN (controller area networking) BUS data link.

- Input from engine *sensors* like oxygen sensor, Throttle sensor, Voltage sensor (idling) and Engine speed sensors are used by the ECU to determine how much fuel is injected and when.

- ECU computes the appropriate load and obtains the fueling rate from the look-up tables called maps stored in ROM.

- An *electronic controller* coverts the fuel information from ECU to mechanical control of fuel delivery.

- Injection pump controls injection rate and timing using *electromagnetic valves*.

- The pump returns information to ECU regarding its current operating state.

Gaurav Tyagi

Engine Control Unit

- It is referred to as the Computer of the Car.

- The ECU uses **closed-loop control**, a control scheme that monitors outputs of a system to control the inputs to a system.

- A modern ECU contain a 32-bit, 40-MHz processor.

- ECU contains Analog to Digital Converter.

- ECU contains Digital to Analog Converter.

- ECU contains Signal Conditioner.

- ECU contains communication chips CAN.

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Sources: http://dodgeram.org/tech/dsl/ISB/Vp44.htm

http://www.howstuffworks.com/car-computer1.htm

Gaurav Tyagi

Homeland Security

Veeravalli, Govindarajan
Srimath

Security Systems

- The mousetrap and the padlock were probably the first security system used by man to protect his home and belongings from possible damage

- Security and the need to feel secure/safe is one of man's most primal needs

- With current state of affairs, security has become a primary concern at home and in the nation

- Security can broadly classified into many categories some being :
  - Home
  - Business
  - Government
  - Industrial
  - Educational and other public institutions
  - Miscellaneous

Veeravalli Govindarajan
Srimath

Security

- Post 9/11 there has been a huge boost in technology for security needs

- Some of the more current trends includes use of biometrics for security purposes

- Given below is an excerpt from an article from BBCi

  "On one computer, a user must scan their fingerprint to log on. Users don't have to remember a password. But if they step away from their terminal, a proximity sensor is triggered and automatically logs users off, forcing them to rescan their fingerprint to log on again."

- The gadget list used for current security purposes is endless and includes handheld scanners, fingerprint markers, secure doors, electronic locking systems , iris scanners, closed circuit cameras mounted on roving pedestals, proximity sensors, motion scanners, …. The list goes on

Veeravalli, Govindarajan Srimath

Security

- Online links for "security"

- http://www.thinkgeek.com/gadgets/security/

- http://news.bbc.co.uk/2/hi/technology/2494167.stm

- http://www.netgadget.net/unhomsec.html

- http://www.kopes.com/gadgets/security/

- http://electronics.cnet.com/electronics/0,10000,0-4016-7-281046,00.html

- http://www.smartcomputing.com/articles/archive/c0201/45c01/45c01.pdf?guid=s0h43lm0

- http://www.msnbc.com/news/729756.asp

Veeravalli, Govindarajan
Srimath

Security

- Food for thought will be the next big thrust area where security has to be provided

- What about machines ? Machines as in valuable irreplaceable machines such as battle tanks, aircraft, trains, large industrial machines ?

- A system is needed which would possibly mimic our immune system to prevent any malicious tampering with these machines

- Some kind of mobile micro robot, which would communicate with each other using blue tooth technology and move to the area where an attack on the machine is anticipated to ward it off.

- It would definitely be a great counter against stripping down of machines for reverse engineering or sabotage of sensitive equipment

Veeravalli, Govindarajan Srimath