

# Part IB Group Project Design Briefs 2016

## Architecture for a Video Facebook

*Client: Richie Jones, Boeing*

Kids love YouTube, but video is currently very one-dimensional - play, rewind, fast-forward. In contrast, the Facebook "timeline" is actually a multimedia narrative, weaving in conversations, status updates, links to friends and so on. Your task is to make a video alternative to Facebook, in which videos can be mixed with each other, and with text and drawings, allowing users to create their own narrative storyline - almost like a personalised video game (imagine a Mashup of Sims 3 and Little Big Planet 3). The architecture to support arbitrary non-linear combinations of different media will be a technical challenge. You could model it on the SuperCollider synthesis server for realtime networked music, but substituting (possibly low-res) video and graphics streams for audio data, and image blends or overlays for audio filters. Start with a locally-hosted version, and think about a cloud service version (probably with lots of local media caching) as an extension..

## Citizen Science for Cancer

*Client: Morten Kallberg, Illumina*

Many people enjoy helping with research by completing simple but satisfying classification and recognition tasks online. Examples include the classic Galaxy Zoo, and recent initiatives such as the BBC Your Paintings Tagger. This project aims to design a similar approach to recognise cancer mutations from gene sequencing data, comparing sequences that are different between cancer mutations and healthy cells from the same person. It is relatively easy for people to spot the difference between actual cancers and false positive mutations - your job is to design an engaging online game teaching people to do this task well, and an infrastructure for collecting and analysing the results from large numbers of volunteers, with appropriate account management, motivation scoring and other features that result in effective citizen science projects.

## Digital Currency for Public Good

*Client: Jan Kis, IMC*

The digital currency Bitcoin uses a block chain distributed database to guarantee that any transaction can be traced to a unique original coin. The same technique could be used for anonymous authentication of a chain of custody for other kinds of data. Your task in this project is to create a secure end-to-end system for authenticated reporting and verification of organised criminal activity, corporate

safety violations, governmental human rights abuses etc. You need to think about how reports can get into the system safely, and how those receiving a report can use the block chain to prove that the evidence has not been tampered with, all without endangering the whistleblower.

## Drive by Age

*Client: Dana Ma, JPMorgan with AgeUK*

It is often difficult for young people on the roads to remember that older people (such as the Group Project Coordinators) see the world very differently - sensitivity to light decreases dramatically, while reaction times, awareness of peripheral movement, distance vision, hearing and fine motor control can also change a great deal. Your task is to make a driving simulator that allows a user to drop through from Google Maps into an alternative interactive Street View as experienced by an older person driving a car. You should simulate particularly challenging situations such as night-time with cyclists having dark clothes and no lights. It should be possible to see any neighbourhood in the UK, from the perspective of a wide range of different ages, and with the experience as realistic as possible. You could even control the simulation on the basis of local demographic data, so that popular retirement destinations can be seen from the point of view of their residents.

## Dynamic Narrative

*Client: Sean Storey, Jagex*

Narrative-led games like Telltale's The Walking Dead and The Wolf Amongst Us present the player with a multilinear narrative driven by a decision-based game engine. Your goal is to take this to the next level, where the player can play several characters that have all experienced the same event, and do this in any sequence. Each decision will have an impact on the game's visuals, positioning of props and dialogue options. The focus should be on delivering a system architecture and tools that allow developers to track the logic of player decisions and alter the state of the game based on those decisions, including any knock-on effects that each decision may or may not have on the rest of the game. Rendering and player controls can use a standard game engine, but content should be driven by your original narrative architecture.

## Edible Lego

*Client: Vaiva Kalnikaitė, Dovetailed*

It's great fun to make elaborate decorations out of chocolate, but hard to make anything really

impressive, because big complex moulds are impractical to commission. Your task is to make a 3D chocolate sculpture tool that takes a (somewhat) arbitrary 3D shape, and decomposes it into pieces that can be assembled from standard shaped blocks such as chocolate bars. However, any unusual local details will need to be queued offline to order a 3D-printed mould for that specific part. You will have access to a basic 3D printer for testing purposes. Unfortunately the Lab cannot supply chocolate, but this project could be a good starting point for a revenue-making business model.

### **Equity Exchange**

*Client: Matt Johnson, Frontier*

The crowd-funding proposition (e.g. Kickstarter) is simple - give us your money, we'll make a product. So is Mechanical Turk - do our menial task, we'll give you money. What about situations where everyone is adding value, and the rewards should be shared (or negotiated) in proportion? Many startups, indie video games, and social enterprises work this way. Because there are no suitable online platforms for negotiating and setting them up, at the moment everyone involved has to live in the same place, whether Silicon Valley or Cambridge, to work it out over endless macchiatos. Your task is to create an online service that uses artificial intelligence approaches to help potential co-founders form a team, and create a fair legal framework, financial structure and investor/market engagement mechanisms. Software startups would expect all of this to sit on top of a Github-style repository for content and code, customised to their individual needs. If there is a market here, you're free to use the result to bootstrap your own business!

### **Eye-Tests on Demand**

*Client: Peter Thomas, Addenbrooke's*

Everyone is familiar with visual acuity tests, where you read an eye chart on the wall, while a nurse or optometrist asks which letters you can see. These are expensive and time-consuming to run, but there may be alternatives. Imagine a display screen on the wall of a chemist, a doctor's waiting room, or a driving test centre, running the eye test as a full-screen page in a standard browser. You take out your phone, connect to a shared web server using an on-screen QR code, then stand in the spot marked on the floor at a calibrated 4m distance. All remaining instructions are delivered over audio from your phone headset, with any necessary interaction eyes-free (e.g. 'touch the left of your phone if you can see a "b", touch the right if you see a "d"'). You should ensure that the result is private and secure, including a mechanism to send you the results by email without bystanders seeing

who you are (remember that the people being tested may be elderly, with poor eyesight).

### **Fly-past Finance**

*Radmilo Racic IMC*

We think the Oculus Rift can be used to navigate complex and correlated financial data using virtual reality. Your goal is to integrate time series data on global futures, stocks, bonds and currencies with trader sentiment and pin point market moving trades. The team will be provided with time series data from Eurostoxx, DAX, CAC, KOSPI, Nikkei, ES, EUR/USD, T-Note, GBL, etc. The VR interaction module should allow users to look left and right to see the past and future, nod forward and back to zoom in and out for more detail. Other movements, such as leaning to the left or right, could be used to select data sets or analyses.

### **Intelligent Game Designer**

*Client: Vince Darley, King Digital Entertainment*

There has been a lot of recent publicity about the success of CST alumnus Demis Hassabis' company Deep Mind, in creating an AI system that can learn to play 1980s arcade games. Of course, there is not much profit in playing computer games - the real business opportunity is designing them! The goal of this project is to create a fully automated AI system that can design original new levels of a casual game such as Candy Crush Saga. There is an art in designing good levels - they should be easy at first, get a lot harder, but be ultimately solvable. You will need to construct a population of simulated players, at all different levels of ability, to assess the quality of the levels generated. By optimising simulated play, each level should be challenging and motivating, while also being aesthetically pleasing.

### **Listening to a Million Voices**

*Client: Chris Smith, Jagex*

Automated sentiment analysis tools are big business, but often inaccurate - consider the difference between the tweets "practically the best game I've ever played" and "hardly the best game I've ever played", which can get very similar scores. A key to future success will be far more rapid training, collecting actual human responses to huge data sets. Your task is to create an engaging interface for navigating and coding millions of items from in-game chat and forum posts. Analysts should start by typing a word, with the system responding by showing frequency-weighted distributions of neighbouring words from all other texts. Users should be able to move left and right, filter out texts they are not interested in, and "deep-dive" to check meaning of individual texts. The system should dynamically build

a thesaurus, learning which words might have similar meanings from context, and adjusting the sentiment weighting of words and phrases. You'll need to use a super-fast index algorithm such as the Symmetric Compacted Directed Acyclic Word Graph from Schulz & Mihov. The client will provide a sanitized set of chat data from their own industry-leading games, and would appreciate a dashboard-style visualisation of current status.

### **Pebble Jogging App**

*Client: Dong Fang, Bloomberg*

We would like you to make a hazard warning app on the smartwatch Pebble. When a user takes their Pebble for a jog, he/she can record GPS location and details of any potential hazard they come across on the road, such as broken pavement, dog dirt, flooding... After the run, they can pair their Pebble to a computer program or mobile app, and upload the data via an interactive map. This allows other Pebble users to download the data, and receive an alarm when they are near the hazard. The relatively constrained set of controls on the Pebble, and the constraint that the jogger will want to work quickly before cooling down, means that you will need to provide a intelligent text entry method.

### **Pocket Brain Surgeon**

*Client: Michael Gifford, Obex Technologies*

Brain surgery is difficult, but some procedures are quite routine. The surgeon could have an Android app with some understanding of the different options at each step of the procedure, that would advise on the best option at each step, based on statistical likelihood of success. The necessary raw data for these decisions is available in national data archives such as the UK Shunt Registry in Cambridge. However, this data is highly sensitive and confidential. You need to design a system that allows brain surgeons to authenticate themselves online before they go into the operating theatre, then download an encrypted data set that can be used to deliver customised guidance from their phone during surgery. Needless to say, the user interface is rather critical - the surgeon's actions must be communicated to the system without interrupting anything important, and any questions about what to do next involve minimum button presses before an answer is delivered (perhaps by speech output, from underneath the surgeon's sterile gown).

### **Put your Phone to Work**

*Client: Dominic Nancekievill, G-Research*

When people browse social media sites on their phones for hours every day, most of the CPU power goes unused. The old desktop equivalent of this

problem was the screensaver, which did little of value until it was co-opted for distributed computing projects such as SETI@home. Your task is to make a platform that can perform useful computation in the background on a large number of mobile phones, while the owners are on social media - or even while they are asleep. It will have to run cross-platform, perhaps using JavaScript, but must also give the appropriate incentives to users - will it drain batteries or incur network charges? If so, what kind of application would customers pay to run on such a platform? Would phone sensors offer any specific value? You need to demonstrate an end-to-end solution including servers, mobile clients and an example application, keeping in mind the security implications if either customers or phone owners try to cheat the system.

### **Reducing Food Waste with IoT**

*Client: Vaiva Kalnikaitė, Dovetailed*

15 million tonnes of food are thrown away every year in the UK alone and almost 50% of this comes from our homes. It seems likely that Internet of Things (IoT) devices, mobiles and wearables could be used to detect and avoid some causes of this problem, for example by sharing surpluses or reducing stockpiles by sharing "buffers" of food between neighbours. Your task is to recover some traditions of sharing food among neighbours, with a community platform that enhances social connections through sharing food. Your client will provide a prototype of one novel IoT device - "Spare Bite" ([www.sparebite.com](http://www.sparebite.com)), but you should also consider the ways that other connected devices may contribute - iPads used in the kitchen for online recipes, or even the infamous Internet Fridge.

### **Safer Chicken from Farm to Fork**

*Client: Gerard Hester, Morgan Stanley*

The campylobacter bacterium is commonly found in the UK food chain, causing 22,000 hospitalisations and 110 deaths each year. It is important for schools to teach basic principles for avoiding infection in farms and shops or cross-contamination between uncooked chicken and other food or utensils. Your task is to design a distributed whole-class education app, in which everyone in the class must learn together what steps to take, acting at the same time. You could base this on the popular Crossy Road game, but adopting a farm and kitchen setting. The whole class should learn to cooperate in guiding a new-born chicken as it travels from farm to fork, making decisions based on what they have learned.

### **Sailing by Sound**

*Client: Lancelot Robson, Metaswitch*

People with visual impairments enjoy outdoor activities as much as we all do, and local sailing organisations are pleased to provide opportunities for disabled and visually impaired people to experience sailing. One disappointing limitation is that the standard navigation instruments (location, windspeed, compass heading etc) all have visual readouts, so visually impaired people are not able to participate in this central aspect of sailing. Your task in this project is to create an embedded device (you will have technical assistance with hardware - bdj23@cam.ac.uk) that uses a Raspberry Pi to communicate with navigational instruments using the NMEA2K standard, and provides users with speech output in response to commands given via a small number of waterproof buttons on the outside of the unit.

### **Simulated Stock Exchange**

*Client: Piers Thompson, BAML*

Almost all stock trading is now done by algorithms. Early profits have reduced, and algo-trading strategies must adapt quickly to the changing economic environment, market movements and technological advancement. The most common way to evaluate a new strategy is to “back-test” it against historical market moves, which has the benefit of being based on real data but doesn’t predict how the market will react to the introduction of a new strategy. The aim of the project is to build an online platform to allow competitive testing of algos on a shared simulated exchange with both historical and live market data. The platform will provide an API to access market data and issue orders to the exchange. The user-developed algos will compete against each other interactively and a reporting service will display the analysis of the relative profitability of each strategy and track the best algorithms on a leaderboard. Students will be provided with an algo pseudo code and examples of sources of market data

### **Surprise the Singularity**

*Client: Andy Fawkes, Bisimulations*

If Singularity is achieved and a super-intelligent artificial intelligence takes over the world, Cambridge is likely to be the first target. The Singularity is not actively hostile to humanity but it will aim to control all movement of vehicles and people so it can prioritise its transport needs over humans. Unfortunately, important strategic information has been published online, where the Singularity can easily find it. For example, the Computer Lab layout is at <https://www.cl.cam.ac.uk/research/dtg/openroommap/>, and the University map at <https://wiki.cam.ac.uk/university-map/>. Your task is to confuse the Singularity by creating distractor maps,

navigated in a way that a disembodied mind might not realise are impossible, for example as Moebius strips or non-Euclidean spaces. Don't show the whole map at once, where the edges will spoil the illusion. But do include a simulation of real activity - public transport synced with real-time information from Cambridge buses, simulated self-driving cars, and of course locative social media messages from the (simulated) people in the panicking crowds.

### **The Busking Bus-Stop**

*Client: Ian Lewis Cambridge Infrastructure Investment*  
Cambridge buses are fitted with GPS tracking equipment. This is used to predict the arrival time for the next bus, as displayed on many bus-stops around the city. It is also collected in an archive of all bus journeys. It would be nice if the display provided more information, and did so in a more entertaining way, customised depending on how long the bus will take to arrive. Information snippets might include confidence intervals (in layman's terms) for actual arrival time based on historic data, and comparisons to other journey options. Entertainment might be automatically generated poems, fictional dialogues etc, that adapt intelligently to local context such as weather information, news stories and so on - but at a length appropriate to the remaining time. With luck, we hope to deploy the resulting system - at least on the stop outside the Gates building!

### **The Politics of Wikipedia**

*Client: Ben Scott, Amazon*

Much of the content of Wikipedia is encyclopaedia-like, but Wikipedia editors also respond to current events. The goal of this project is to highlight which parts of Wikipedia are more political (or at least contemporary), by correlating Wikipedia edits with recent traffic on Twitter. You should create a custom application for viewing Wikipedia, in which the content the user sees is customised and updated to follow Twitter traffic. Users should be able to navigate according to recency, popularity, or controversy. They should also have some way to know (through correlation analysis) when different topics or pages appear to be alternative views of the same underlying events.