School of Electronics and Computer Science
ELEC6050 MEng Group Design Project

Project Specification and Plan

Title: Unmanned Aircraft Camera Module (GDP Group 18)

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Customer: Dr. Matt Bennett, SkyCircuits (m.bennett@skycircuits.com)

Project Specification:

To design, build and test an electronic module capable of capturing still images from an unmanned aerial vehicle (UAV) and transmitting the images to a base station. The module must use the UAV autopilot's low-bandwidth RS485 serial link (38.4 kBaud). A program must be written to interface with the base station software over a TCP/IP link, allowing image data to be received and displayed to the user. The electronic module will be constructed using strip-boards and will later be implemented on PCB if time is available.

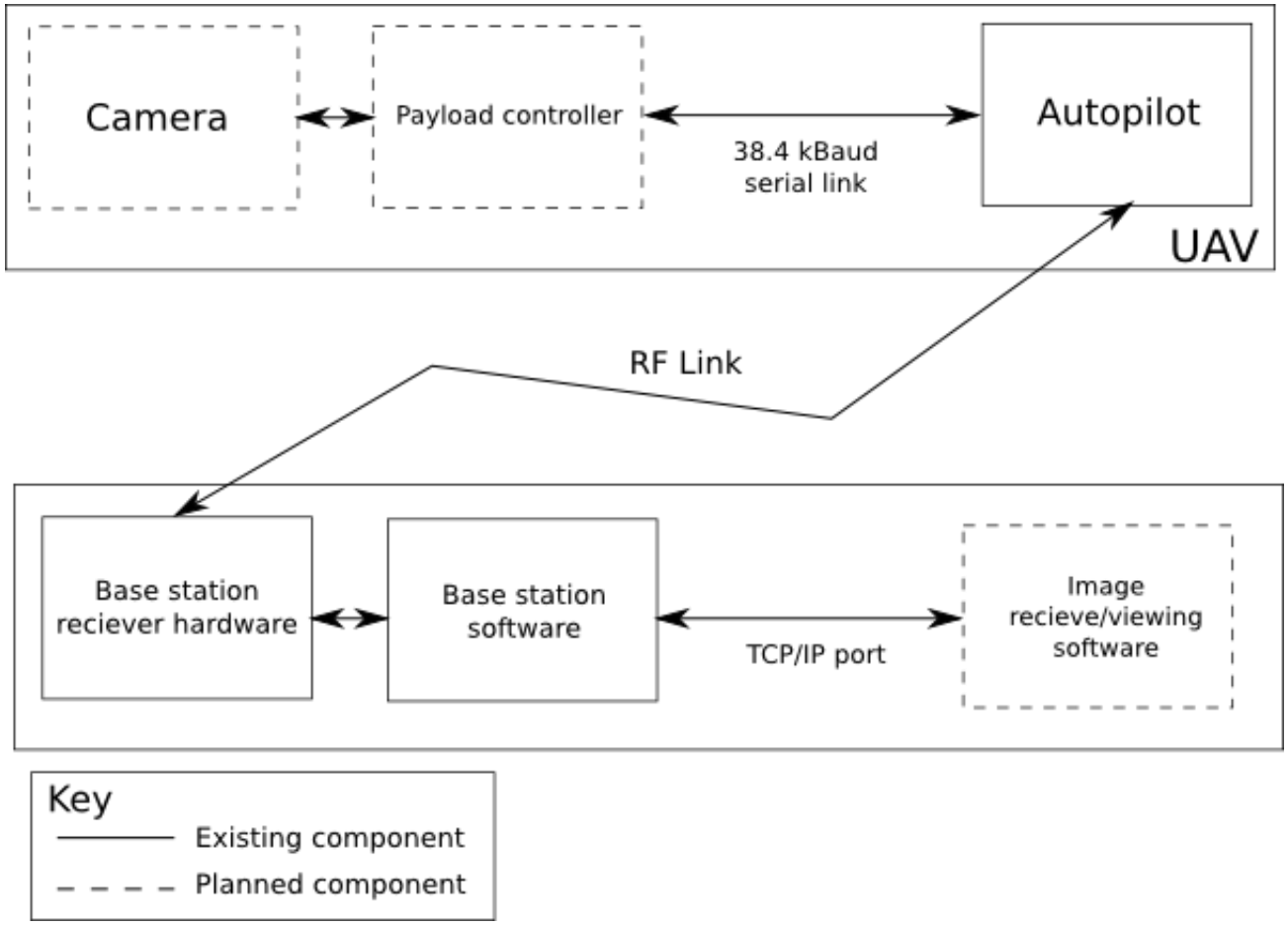
The aim of the project will be to achieve the following criteria:

- The image will be encoded in such a way that a low quality image will be available quickly, the quality of which will improve as more information is downloaded. [high priority]
- Minimise the time needed to download the images from the UAV to the base station. The time from the user's prompt until the image has been fully downloaded will be measured against the theoretical 3 minutes necessary to transmit a full image without using any compression. The goal will be to obtain a full image in **less than 3 minutes**. [high priority]
- The module weight will be **less than 250g**. [medium priority]
- Image resolution of **640x480**. [medium priority]
- Allow the user to perform the following actions on the UAV's camera from the base station:
    - Prompt the UAV to **capture and download an image.** [high priority]
    - **Cancel** the downloading of any image while the image is being downloaded. [medium priority]
    - **Resend** an image in case the current preview is corrupted. [low priority]
    - **Interrupt** the download of an incomplete image and allow the user to **save** the incomplete image. [low priority]
    - Select the **resolution settings** of the image. [low priority]
    - Display a **progress indicator** which will show the percentage of the image data received, as well as a time estimate for the rest of the image to be downloaded. [low priority]
    - The image capture will be triggered automatically by the UAV using triggers built into the autopilot. [low priority]
    - Allow the user to command the image capture to **trigger periodically** over a **user-specified time interval** will be added if time permits. [low priority]

- Images will be transmitted in **colour** as opposed to black and white. [low priority]
- The user can select between a colour image and a black and white. [low priority]

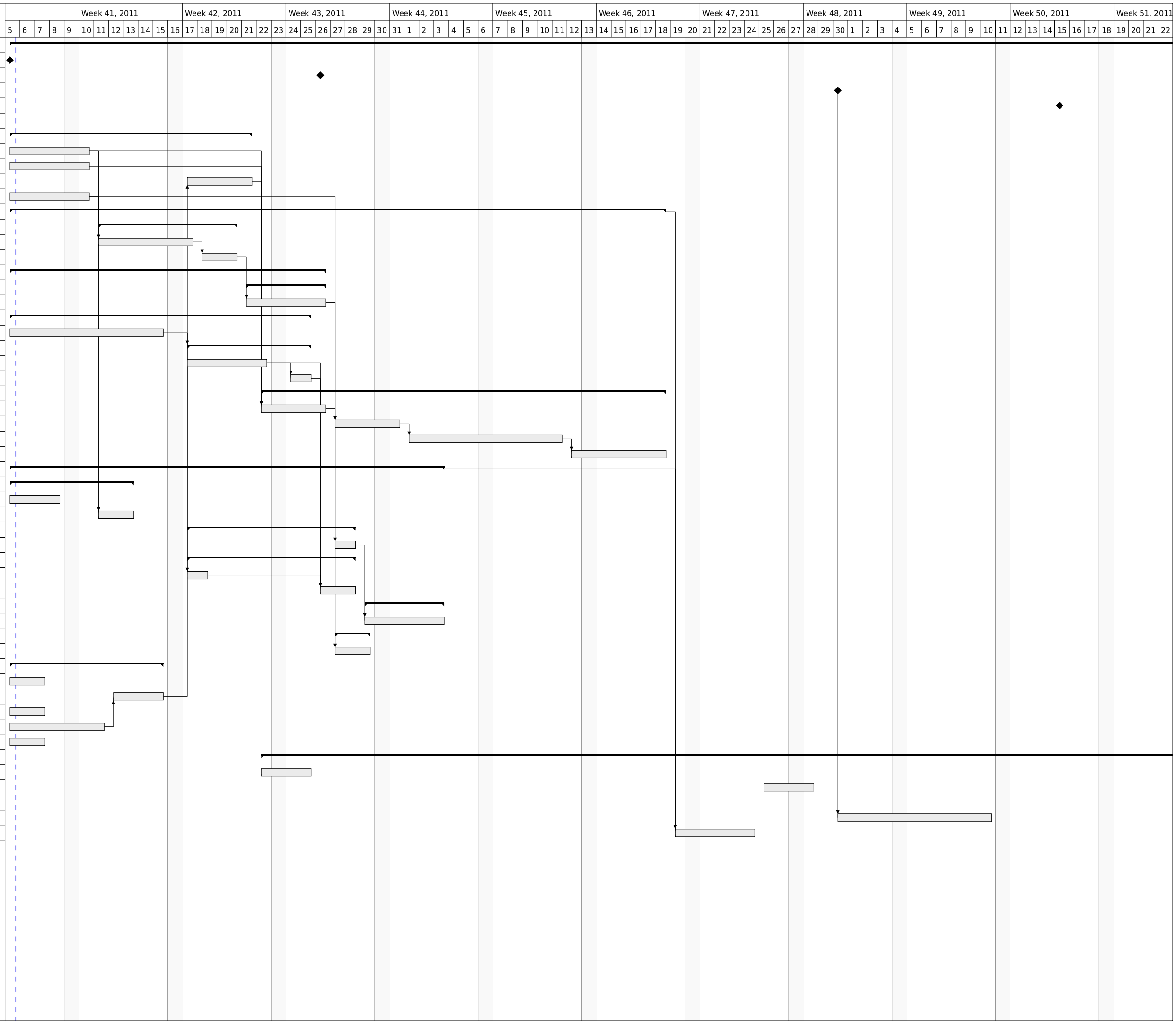
Deliverables to the customer include:

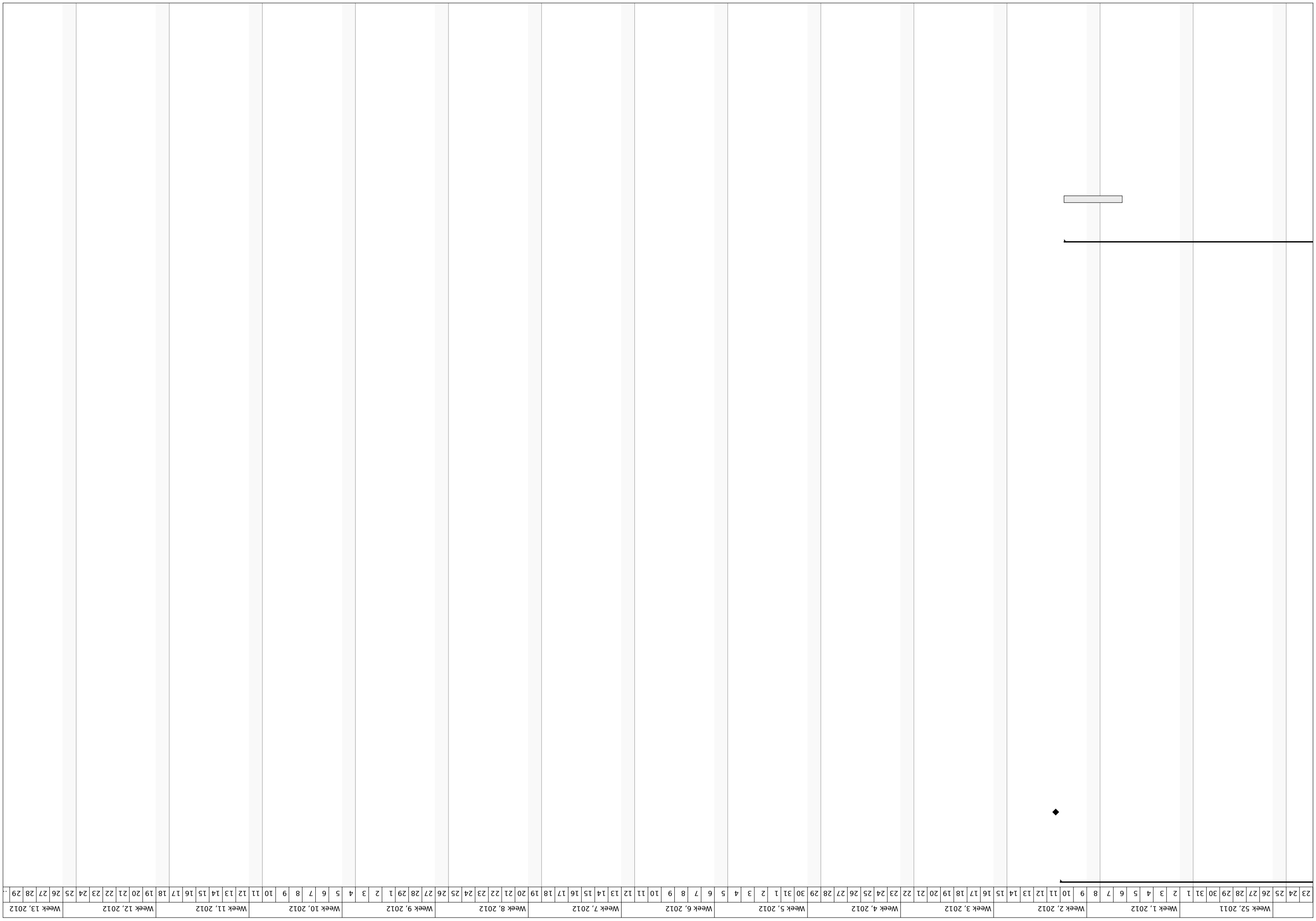
- Hardware: Camera module, constructed on PCB (if time permits, otherwise on strip-board), including layout designs.
- Software: all firmware for the electronic module, and software on the base station for viewing images. The full source code and all executable files will be included.
- Documentation: Technical and User Documentation. This includes all schematics related to hardware as well as all other documents concerning both the software and hardware delivered.
- Public repository: The full source code, all schematics, and all documents concerning both the software and hardware will be included on a public repository so that the client may share this information with his clients.



Complete Block Diagram of the System

Name	Work
Deadlines	
Opening lecture	
First progress seminar	
Second progress seminar	
Final report	
Final presentation	
Acquire Equipment	**20d**
Acquire camera	5d
Acquire Schematic Parts	5d
Acquire final payload controller	5d
Acquire autopilot and basestation	5d
Payload Module	**56d**
Camera module communication	**9d**
Prototype camera module communication	6d
Payload controller <-> camera module communication	3d
Image Encoding and Transmission	**23d**
Basic Raw encoding/(JPEG?)	**5d**
Payload controller implementation	5d
Custom (compressed) encoding	**18d**
Matlab algorithm prototype	10d
Payload controller implementation	**8d**
Compression algorithm implementation	6d
Data breakdown and transmission	2d
Payload module construction	**24d**
Payload breadboard prototype	4d
Payload PCB design	4d
Aquiring payload PCB	10d
Payload PCB construction and debugging	6d
Image recieve/viewing software	**19d**
TCP/IP Basestation Communications	**7d**
Basic dummy server communication	4d
Basestation communications	3d
Decode Image	**7d**
Basic image decoding	2d
Custom (decompression) decoding	**5d**
Matlab algorithm	2d
Working implementation	3d
UI	**5d**
Functional user interface	5d
Integration	**3d**
Payload controller to autopilot/base station	3d
Background Research	**19d**
Camera selection	3d
Payload controller (e.g. microcontroller/FPGA) selection	4d
Communication protocols	3d
Image processing/compression	6d
Programming language	3d
Prepare presentation	**10d**
Progress seminar 1	3d
Progress seminar 2	3d
Final presentation	4d
Report Writing	10d
Whole System Testing	5d




Week 52, 2011
Week 1, 2012
Week 2, 2012
Week 3, 2012
Week 4, 2012
Week 5, 2012
Week 6, 2012
Week 7, 2012
Week 8, 2012
Week 9, 2012
Week 10, 2012
Week 11, 2012
Week 12, 2012
Week 13, 2012

WBS	Name	Start	Finish	Work	Duration	Slack	Cost	Assigned to	% Complete
1	**Deadlines**	**5 Oct**	**11 Jan**		**84d**		**0**		0
1.1	Opening lecture	5 Oct	5 Oct	N/A	N/A	84d	0		0
1.2	First progress seminar	26 Oct	26 Oct	N/A	N/A	66d	0		0
1.3	Second progress seminar	30 Nov	30 Nov	N/A	N/A	27d	0		0
1.4	Final report	15 Dec	15 Dec	N/A	N/A	23d	0		0
1.5	Final presentation	11 Jan	11 Jan	N/A	N/A		0		0
2	**Acquire Equipment**	**5 Oct**	**21 Oct**	**20d**	**15d**	**69d**	**0**		0
2.1	Acquire camera	5 Oct	10 Oct	5d	5d	50d	0		0
2.2	Acquire Schematic Parts	5 Oct	10 Oct	5d	5d	50d	0		0
2.3	Acquire final payload controller	17 Oct	21 Oct	5d	5d	40d	0		0
2.4	Acquire autopilot and basestation	5 Oct	10 Oct	5d	5d	71d	0		0
3	**Payload Module**	**5 Oct**	**18 Nov**	**56d**	**39d**	**40d**	**0**		0
3.1	**Camera module communication**	**11 Oct**	**20 Oct**	**9d**	**9d**	**65d**	**0**		0
3.1.1	Prototype camera module communication	11 Oct	17 Oct	6d	6d	53d	0		0
3.1.2	Payload controller <-> camera module communication	18 Oct	20 Oct	3d	3d	53d	0		0
3.2	**Image Encoding and Transmission**	**5 Oct**	**26 Oct**	**23d**	**19d**	**60d**	**0**		0
3.2.1	**Basic Raw encoding/(JPEG?)**	**21 Oct**	**26 Oct**	**5d**	**5d**	**60d**	**0**		0
3.2.1.1	Payload controller implementation	21 Oct	26 Oct	5d	5d	53d	0		0
3.2.2	**Custom (compressed) encoding**	**5 Oct**	**25 Oct**	**18d**	**18d**	**61d**	**0**		0
3.2.2.1	Matlab algorithm prototype	5 Oct	15 Oct	10d	10d	58d	0		0
3.2.2.2	**Payload controller implementation**	**17 Oct**	**25 Oct**	**8d**	**8d**	**61d**	**0**		0
3.2.2.2.1	Compression algorithm implementation	17 Oct	22 Oct	6d	6d	58d	0		0
3.2.2.2.2	Data breakdown and transmission	24 Oct	25 Oct	2d	2d	58d	0		0
3.3	**Payload module construction**	**22 Oct**	**18 Nov**	**24d**	**24d**	**40d**	**0**		0
3.3.1	Payload breadboard prototype	22 Oct	26 Oct	4d	4d	40d	0		0
3.3.2	Payload PCB design	27 Oct	31 Oct	4d	4d	41d	0		0
3.3.3	Aquiring payload PCB	1 Nov	11 Nov	10d	10d	40d	0		0
3.3.4	Payload PCB construction and debugging	12 Nov	18 Nov	6d	6d	40d	0		0
4	**Image recieve/viewing software**	**5 Oct**	**3 Nov**	**19d**	**26d**	**53d**	**0**		0
4.1	**TCP/IP Basestation Communications**	**5 Oct**	**13 Oct**	**7d**	**8d**	**71d**	**0**		0
4.1.1	Basic dummy server communication	5 Oct	8 Oct	4d	4d	75d	0		0
4.1.2	Basestation communications	11 Oct	13 Oct	3d	3d	71d	0		0
4.2	**Decode Image**	**17 Oct**	**28 Oct**	**7d**	**11d**	**58d**	**0**		0
4.2.1	Basic image decoding	27 Oct	28 Oct	2d	2d	53d	0		0
4.2.2	**Custom (decompression) decoding**	**17 Oct**	**28 Oct**	**5d**	**11d**	**58d**	**0**		0
4.2.2.1	Matlab algorithm	17 Oct	18 Oct	2d	2d	64d	0		0
4.2.2.2	Working implementation	26 Oct	28 Oct	3d	3d	58d	0		0
4.3	**UI**	**29 Oct**	**3 Nov**	**5d**	**5d**	**53d**	**0**		0
4.3.1	Functional user interface	29 Oct	3 Nov	5d	5d	53d	0		0
5	**Integration**	**27 Oct**	**29 Oct**	**3d**	**3d**	**62d**	**0**		0
5.1	Payload controller to autopilot/base station	27 Oct	29 Oct	3d	3d	62d	0		0
6	**Background Research**	**5 Oct**	**15 Oct**	**19d**	**10d**	**74d**	**0**		0
6.1	Camera selection	5 Oct	7 Oct	3d	3d	81d	0		0
6.2	Payload controller (e.g. microcontroller/FPGA) selection	12 Oct	15 Oct	4d	4d	40d	0		0
6.3	Communication protocols	5 Oct	7 Oct	3d	3d	81d	0		0
6.4	Image processing/compression	5 Oct	11 Oct	6d	6d	40d	0		0
6.5	Programming language	5 Oct	7 Oct	3d	3d	81d	0		0
7	**Prepare presentation**	**22 Oct**	**10 Jan**	**10d**	**69d**		**0**		0
7.1	Progress seminar 1	22 Oct	25 Oct	3d	3d	66d	0		0
7.2	Progress seminar 2	25 Nov	28 Nov	3d	3d	37d	0		0
7.3	Final presentation	6 Jan	10 Jan	4d	4d		0		0
8	Report Writing	30 Nov	10 Dec	10d	10d	26d	0		0
9	Whole System Testing	19 Nov	24 Nov	5d	5d	40d	0		0