PROJECT ALERT

Middle Division

Team CmPS

PROJECT ALERT

PART I: PROJECT OVERVIEW

AREA OF CONCERN

Recent census information indicates that just under 400,000 New Zealanders suffer from some degree of hearing impairment. For around 800 young New Zealanders aged between 11 and 18 the level of their disability means that they are enrolled, for their secondary schooling, with a deaf education provider rather than a mainstream school. In Auckland Kelston Deaf Education Centre (KDEC) meets this need. KDEC's students in this age group do not however all attend a single "deaf school". The students attend 4 satellite schools across the city. KDEC receives the funding for these students and provides specialist teachers, learning assistants and interpreters to support the students in their satellite school. Wherever possible students attend classes with their hearing peers, with support, but at other times are withdrawn, for intensive sign or verbal language support.

Mission Heights Junior College (MHJC) opened in South Auckland in 2009 and agreed to be a "temporary" satellite school from 2010 until a planned campus of new primary, middle and senior schools is opened on a single site in this part of Auckland. These three satellite schools will eventually provide a pathway for KDEC students with purpose built facilities within the mainstream school communities. The senior school opened in 2011, the primary will open in 2015 but construction of the Junior College has already been delayed once due to the economic down turn and a slow down in building in this new suburb. Most recent projections put the earliest opening date for this school as 2017.

MHJC continues therefore to welcome KDEC students and for the most part this is proving highly successful but the fact is that the school was not built as a permanent KDEC satellite and this has meant that some of the facilities which will be in the planned satellite schools are not available. Neither the Ministry of Education nor KDEC will invest in this "temporary" situation and MHJC receives no funding to do so. Compromises are therefore necessary and at times these are less than ideal.

Imagine this scenario: It is a normal school day at MHJC. Some of the 14 deaf students are working on the computers in the open central area of their building. Others are working in a nearby classroom. Their teachers circulate between the groups but, as is the culture of the school, these students are working without constant supervision on their research work and are making good progress. Other mainstream students occupy the computers around them and they too are working intently on their work. Suddenly the usual busy atmosphere changes. Hearing students jump to their feet and start moving in all directions. With no warning, adults and students emerge from classrooms and move purposefully towards the large entry doors.

At first the KDEC students are unconcerned. Is it the end of the session already? They glance at the clock on the monitor. No. At that moment a KDEC teacher rushes towards them signing for them to hurry up. "What?" they sign back. "Fire" The teacher signs. Instinctively they look around. "Fire or drill?" they sign. "Just hurry- to the courts" signs the teacher. By then all the KDEC students from the classrooms and the central space are being herded towards the door and out to the evacuation area on the tennis courts.

This is a drill but everyone is on edge until this is confirmed. Word spreads from teachers to students and between students. For these students their eyes are their ears. They can only get the essential information they need when they have a clear line of sight to their signing teacher. This is challenging enough in a normal busy school environment, it is doubly so when a tide of students is moving in a wave of bodies in an evacuation situation.

This is the scenario whenever there is a drill or genuine alarm and there have been both. The problems are compounded if students are outside on the fields or in the bathrooms when they can be completely unaware of an alarm. The KDEC students tell of their sense of helplessness and dependence in such situations. They become completely reliant on others and they feel confusion and fear. Their teachers describe the pressure of having to locate and inform each student individually of an alarm. "They are teenagers and they want explanations, not just instructions," the teachers say. This is a potentially dangerous situation. We have alarm systems for the hearing that inform everyone simultaneously because in an emergency time is vital. For the KDEC students this is not the case.

Deaf students were so concerned that in 2012 they lobbied KDEC Management for a visual alarm system. They were unsuccessful due to the "temporary" nature of the arrangement with MHJC. Retrofitting visual alarms would be very expensive and no one is prepared to fund this. The current alarm system at MHJC satisfies requirements for a NZ State funded school. There is no legal requirement to provide an alternative alarm for the deaf students.

And so the KDEC students remain in this situation where their lives could quite simply be on the line. In a hearing world an evacuation alarm is frightening, in a deaf world, the lack of one is even more so.

CHALLENGES IDENTIFIED

Deaf students in N.Z. schools are a small minority and there is no legal obligation to provide appropriate visual alarms for them in State schools. This may be a challenge as their safety may be compromised at school.
The way Deaf education is funded could pose a challenge. KDEC receives and manages the funding provided by the Ministry of Education, while satellite schools, receive no funding and therefore may not be prepared to fund their needs as they would for their other students.
Deaf students who attend MHJC are, mostly, like all the other students but they are aware that they are not getting all the support systems hearing students have. This may lead to them feeling resentful or undervalued.
Deaf students have been told their requests for effective alarms cannot be met because KDEC being at MHJC is a "temporary" situation. But for the individual students there is no logic to this as the situation for them as individuals is not temporary because they have completed, or will complete, their full 4 year cycle in the school just as their hearing peers do. This may leave them feeling discriminated against.
There are potential logistical challenges because deaf students are from different year levels, based in two different buildings, and are often in different mainstream classrooms. In an emergency evacuation situation it could be difficult to locate and safely evacuate each deaf student.
MHJC promotes a culture of developing independent work habits. When students are working they are often not under the direct supervision of a teacher at all times as in a traditional classroom. If students cannot hear the fire alarm, then informing students of potential danger may be a greater challenge.
When deaf students are in the bathroom or on the field they have no alarm at all and they could be completely unaware of an evacuation alarm. This could put them in a life threatening situation.
Because the KDEC unit will not permanently remain at MHJC none of the organisations that would normally be required to provide an alarm system is prepared to pay to retrofit an expensive visual alarm system. This could mean KDEC students are at risk for another three to four years.
Students have identified a health and safety concern but no action has been taken. If there was a fire and a deaf student or teacher was injured or killed because of the lack of an alarm system, the public would probably hold MHJC responsible even though the students are not officially "enrolled" with them. KDEC or the Ministry of Education, who would normally fund alarms in "permanent" satellite schools, could also be held responsible. All three could be considered morally responsible and would face negative publicity.
All the organisations have said they will not provide an alarm system due to the very high cost of doing so. It could therefore be a challenge for us, as a group of students, to raise funds to address this.
As Year 9 students setting out on this project, it could be a challenge for us to have the necessary technical skills to provide an affordable but effective solution for the deaf students.

UNDERLYING PROBLEM

Currently Deaf students at MHJC have no effective fire alarm system. How might Project Alert provide Deaf students at MHJC with an effective fire alarm system, so that these Deaf students can have the same level of safety as hearing students, in case of fire, in 2013 and beyond?

ALTERNATIVE SOLUTION IDEAS

We will again lobby all the organisations who, we believe, have a responsibility to ensure the safety of the students to try to get approval for a visual fire alarm to be installed in the school. We will highlight the health and safety implications.

We will investigate the possibility of sending a visual message from the school's server to every computer screen in the school and to the school's digital notice boards if there is an evacuation alarm.
We will develop a portable personal alarm for all deaf students that will alert them when there is a fire alarm.
We will investigate the possibility of sending a text to the deaf students' phones if there is a fire alarm.
We will develop a peer support system where hearing students will partner with a deaf student who they will support in an evacuation situation.

PLAN OF ACTION

From all our solution ideas we have decided to focus on developing a portable personal alarm for each deaf student which will be linked to the school's alarm system sending a signal to the alarm causing a vibration and/or visual alarm. The reason for this is that we believe this solution will be the most feasible and effective. It does not require the expensive retrofitted wiring which has been turned down by KDEC and the Ministry of Education in the past. We feel that if the deaf students themselves were unsuccessful in lobbying the organisations to provide this high level solution, we are unlikely to have any greater success but we will meet with them to try to gain their support for our final solution.

We know that mobile phone reception is patchy in the school. This is apparently due to thick laminated glass used in our buildings, as we are in a flight path. Also all deaf students do not own phones. Using an alarm which sends radio signals will overcome this problem.

While we can see potential in the idea of the visual display on computer and TV screens, we are concerned that the students would still miss alarms when outside and in the bathrooms and this solution will require advanced computer programming skills.

Our preferred solution will be affordable as it will involve using small electronic components. It will however take some time as we will have to develop skills in both programming and electronics but we know there are many people in the community who can assist us. We will meet with the KDEC students to work with them to develop a list of design specifications to ensure they will be happy with the final product and to ensure they agree that this solution will work for them.

This solution will allow the deaf students to be independent, secure and informed in the event of an evacuation. Because it will be small and portable it will be discreet, which is important to teenagers, especially those with disabilities. Initially our goal will be to make a prototype that can be activated manually but then we will attempt to programme a fully automated alarm.

TIMELINE 2013

February: Meet with KDEC staff; Meet with KDEC students; Create Design Criteria
March: Seek technical assistance for electronics and computer programming. Research existing products which rely on similar technology, such as restaurant pagers. Purchase or acquire components for prototype 1.
April: Dismantle and learn about wireless devices. Begin range testing using walkie talkies. Research online forums using the same electronic components. Apply to Orion Health for a Raspberry Pi as part of the Codeworx Challenge so we can use the Pi for programming our device.
May: Build transmitter; learn basic programming; design receiver prototype using vibrator from mobile phone; test at close range;
June: Test over distance; Target to have fully functioning prototype 1 on “breadboard”; Feedback and demonstrate to deaf students.
July: Learn to solder, Learn to use software to create circuit diagram; transfer receiver to veraboard (soldered) Prototype 2. Test.
August: Feedback to KDEC students; Consult re packaging options; package raspberry Pi and transmitter into a switch box to create a manual system.
September: Present product to CEO of KDEC; investigate options to personalise packaging;
October: Work on programming to automate the alarm by using sound recognition software.
November and December: Continue to work on performance and sustainability and reduce size of the receiver.

PART II: IMPLEMENTATION OF PLAN

ACTIONS AND OUTCOMES TO DATE

Initially we met with the KDEC students and staff to get a better understanding of their situation. They told us that they really wanted a fire alarm in the school and that two deaf students had, as part of a project, tried to get one installed but had failed because of the cost of retrofitting the system in the school and because KDEC would not be permanently based at Mission Heights Junior College.

We also met with management of MHJC who explained that the school had agreed to take the KDEC students, initially only until the end of 2013, and that the school receives no funding. The MHJC Board has now agreed to extend the time until the next new school is built, but as they are doing this out of goodwill and receiving no financial return, they cannot use the school's funds to install a system.

We researched the feasibility of making a portable vibrating alarm for each student. We learned about radio frequencies, including legal restrictions on using some frequencies and we tested potential range on our site using radio-operated walkie talkies. We researched how similar systems such as restaurant pagers work. We found that we would need some basic programming and we would need to build a transmitter and receiver. We discussed this with our IT managers and an electrical engineer, Brendan, from Fisher and Paykel Health Care and despite initial doubts about our ability to be successful, they agreed to help us.

The KDEC students were enthusiastic about the concept of a portable device. From our discussions with them we developed a list of design specifications such as size, cost durability etc. which we would have to meet.

We then went to an electronic warehouse and identified components we would need. We also used the web to see how others had used similar components in different projects. While these were quite different, eg: a GPS system for a glider, they gave us a starting point and we designed our first circuits. We had the idea to use vibrators from old phones in our devices and we contacted Vodafone who donated some old phones to us. We took them apart and took out the vibrators. We also learned about different components as we did this. We had lessons on electronics from our IT manager, Mr. Doughney, and Brendan. We started off building our transmitter and receiver prototypes on “breadboards”, which is a construction base for prototyping of electronics.

We learned that there was a competition run by Orion Health to encourage students to learn to programme. We submitted our project idea and they donated us two “Raspberry Pi” computers to use for our project. Since then we have learned to programme and we also won a multimeter when we had to report on our progress to date on our project. This came in very handy for testing.

Once we eventually had our prototypes working, (we had lots of failures and triumphs!), we learned to use online circuit design software Upverter to draw up our final circuit diagrams. We transferred our receiver components onto veroboard, which is another type of prototyping board, so that we could get our receiver small enough to fit in a Tic Tac box which we decided was an ideal container. To do this we had to learn to solder. We programmed the transmitter to work from a switch and we were in operation. We trialled the device and got feedback on it from the KDEC students. They thought it was great and loved the idea that they could personalise the packaging on their own device too by decorating the Tic Tac box.

We have continued refining our alarm and we have now programmed it to recognise and respond automatically to the school fire alarm without the need for a manual switch. Currently we are attempting to make the alarm even smaller, to use a rechargable battery and to possibly add a light alert as well as a vibration.

ORGANISATION

As a team, we all decided that we wouldn't split up to do specific roles and have specific responsibilities as we wanted to make sure that we all made the most of this opportunity to learn new skills rather than just stick to our existing strengths. This meant we pretty much all did all parts of the technical project together. However we did have strengths and this allowed us to take a lead in some areas and help others where they were not so confident. One organisational thing that really helped us was that we kept records of what we did and achieved as we went.

Dylan: I believe that with us not having a specific job it helped us to enhance and discover new skills. Each of the team members brought different skills to the group and as we progressed on our project, their skills started to rub off onto others and thus enhance all of our skills. I found that I picked up the electronics and programming easily and I was able to help the others learn.

Courtney: I am a good writer and I can communicate with strangers easily but with us all taking a part of these jobs then the load was shared and I got to really develop technical skills I might never have had a chance to do. You are able to see where your hidden strengths lie and improve on your weaknesses. The team all works and helps each other out to make sure we are all learning the same thing and are on the same level.

Cailey: I feel that all of us working together allowed us to learn together as a team. This gave us an opportunity to learn through peers for a better understanding on electronics. We were forced out of our comfort zones and discovered new strengths, for example I really enjoyed the opportunity to use a new software to draw up our circuits. I was jokingly referred to as a "geek chick" because I discovered I had real ability with electronics and programming that I didn't know about before!

RESOURCE IDENTIFICATION AND UTILISATION

Deaf students and KDEC Managers & teachers: Assisted with ideas, feedback and encouragement. *Mr Doughney and Mr Vercoelen:* Provided expert assistance with programming and electronics.
Orion Health: Provided 2 Raspberry Pi computers for our project.
Vodafone: Donated 2nd hand phones.
Online Forums: Assisted us with problems and suggestions.
MHJC teachers and management : Purchased initial electronic components and supported us throughout.
News media: Helped raise public awareness of our project and aims.
IPENZ & Transpower: Published our story in national professional magazines, increasing our credibility.
Phil Faidley, NZ Fire Service: supported us and showed us that our work had potential wider value.
Gay Watson, Futureintech: Took an interest in our work and accessed technical mentoring support for us.
David Foster, CEO KDEC: Pledged support for our project.
Countdown Supermarket: Donated $500 voucher for us to raffle to raise funds.
Technology and Science Competitions: Raised public awareness of our project and provided generous prizes which we used to fund our work.

ACCOMPLISHMENTS and SCOPE

Our biggest accomplishment is that we have been successful in achieving our aim to provide the deaf students in our school with an effective fire alarm system, so that they can now have the same level of safety as hearing students when there is a fire alarm.

In comparison to the prohibitive costs of retro fitting the school with visual alarms, we have managed to do this in a cost effective way with each personal portable device costing less than $50.

We have been successful in attracting a lot of community interest and support which has enabled us to achieve our goal as "experts" have gone from initially doubting our ability to do this to mentoring us, lending us equipment and giving us invaluable feedback and advice.

We have worked through a long development process, creating initial prototypes on bread boards so we could continually make changes before we committing to soldering components onto veroboard as we had to be careful with our money.

We made a first device where the transmitter was activated with a manual switch when the alarm went off and was programmed to then send a signal to activate the vibrating component in the receiver.

We went one step further and programmed our second transmitter to recognise the exact frequency and pattern of the sound of school fire alarm. This automatically activated the signal to the receiver.

We created a receiver that met the design specifications provided by the deaf students and continued working on an even smaller version of the receiver to incorporate a rechargeable battery. This has involved a complete redesign. We have addressed issues of reliability, quality of reception and sustainability.

We have been fortunate in winning a number of awards which have had generous prizes and this has helped fund our work and generated lots of interest in our work. In the Manukau Regional Science and Technology

Fair, from over 150 entries, we placed first in the Technology and Innovations section. We have also won an award for the Best Use of Electronics and an Innovation Award. Our project has also won three major national awards, the Senior Division of the Transpower Neighbourhood Engineers Awards, the Codeworx Challenge and the Middle Division CmPS title.

We have attracted the interest of the media being featured in the newspaper and on national television on Primetime "3 News".

Since the media coverage of our story we have been contacted by a representative of the NZ Fire Service, Mr Phil Faidley, who works with deaf people to make their homes fire safe. He is very excited about our project and wrote a letter of endorsement as he sees huge potential in our device.

The CEO of KDEC was keen to support us in creating a device for each student and sees potential for deaf workers also. He is impressed with our work and sees huge potential for it to support many other Deaf people.

Our success has prompted a lot of interest from professionals. We have been visited by the CEOs of major engineering company Transpower and the Institute of Professional Engineers NZ and our project has featured in national engineering newsletters and magazines. We are aware from feedback from professionals that there is potential for our device to help many others, both deaf and hearing, in other schools and in situations such as noisy workplaces and so there is potential for us to continue to develop our idea.

REFLECTION ON OUTCOMES

Before this project began we all felt that this was a really important issue that needed to be addressed. We felt uncomfortable that a group of students in our school was exposed to risk in this way but when it came to practically achieving our preferred solution, to be honest, we had a lot to learn. Our ability to create an effective electronic device was untested. None of us had done any programming but we were all keen to learn.

Some of us found the technical side of things easier and others were better at communicating what we have done. Our different levels of knowledge and skills on elements of the project allowed us to really improve on our teamwork and engage more as a group. We learned where our strengths and weaknesses lie, and how to complement each other. It got really exciting when we started to build things ourselves and we felt we were going to make this happen when our first prototypes actually worked.

But it wasn't all plain sailing. With both programming and electronics we would find a "bug", eventually fix it and then come back the next week and find another problem and at times it did get a bit discouraging. Sometimes we felt like we would never get our device to work and then we would check our work, seek advice and make another breakthrough. We learned that while it is hard to make something work, it is also hard to completely wreck your project so you just keep trying new things.

The reaction of the deaf students throughout the process was very encouraging. They were very grateful when we fed back on our progress and we noticed that they began to acknowledge us around the school which was amazing. The teachers fed back to us that the students felt really valued that we would give up so much of our time to create something for them.

Once we had created the manual switch version of our device, we had a system that satisfied our UP but we were so encouraged by the reaction we had had from not only the deaf students but also professionals such as engineers and programmers that we were encouraged to go to the next level. We set out to automate the system and felt that once we had achieved that we had a much safer system that would not rely on someone remembering to activate the alarm, but would still allow a manual over ride if the automatic system failed for any reason. We also decided that the deaf students deserved a professional looking device so we kept working on making the device smaller. We also wanted to use a rechargeable battery to improve cost effectiveness so that meant more design work.

Now we know that the Deaf students have an affordable and effective device we can feel really satisfied that we have achieved our aim and we are very proud of that. We have not completely given up on the additional solution of trying to send a visual signal across the school network. This would not replace our current solution but would complement it and could also offer the chance to use the system for other emergency situations, such as a lock down, for all students in the school.