INTERACTIVE DEVICE FOR SCHOOLS
REDESIGN OF CLICKER SYSTEM

INDUSTRIAL DESIGN PROJECT II

MPR 437

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1. INTRODUCTION

Fig 1: child labour in India

Education plays very important role in any person's life. Today everyone irrespective of their economical status peruse education. But still there are many instances where the students from economically backward class dropout in school level and start working for their livelihood. Economical condition is not the sole reason for this situation. Sometimes failing in exam, unable to understand the concepts taught in class and psychological or health related issues. This project focus on designing a product or tool that will assist students in their learning in school. So that the dropouts will be reduced.

2. RESEARCH

2.1 Visit to Aarambh NGO in Navi Mumbai

Fig 2, 3 Visit to Aarambh NGO in Navi Mumbai

The NGO works towards educating economically backward children in slums. The discussion with the founder trustee Ms. Shobha Murthy gave insights to problems faced by organizations like them.

2.2 Observations from the Visit

Major issues perceived

Organization level

Visit to the NGO threw light on the lack of attention paid to economically backward education by government of Maharashtra per say. The fact was taken with a grain of salt, as NGOs mostly speak of such laxity in government policies and funding opportunities.

The ground state of education in economically backward Maharashtra did not seem optimum or exemplary

Teachers

Since teachers in these schools had also been products of the same education system at these schools, they themselves were seen to lack the motivation and readiness to contribute towards the improvement of the system

"Even if computers are present in schools, teachers mostly do not know how to operate them"
-an NGO worker

A few new age teachers were still interested to make an initiative but the third (and probably the most important stakeholder)- students turned out to be a major issue in the ecosystem

Students

It is often perceived that parents in economically backward areas are not willing to send their kids to school. But the story from these visits revealed a new facet altogether.

In today's age, parents are aware of the benefits of education and hence are willing to do more than they can and send their kids to schools, while the students do not wish to go to schools.

"Why should I go to school, when you see XXX who is the same age as mine, working in a factory and making money"
"School is boring, real life is outside school" - ***students***

Teachers also admit to the problem
"parents are willing to work two shifts if required to keep the students in school, but their kids are just not willing to come, attendence scenario is very sad"

Problem identification process

A deep dive into the story from the student's POV (point of view)

"A lot of time these students train us on different planting techniques etc when we work in our school gardens, they have much more knowledge than us in agriculture"
- Teacher

"Our family specializes in making ravanas for Dussehra, that is where we earn our living from, in school our art periods are also taken up to teach theory and irrelevant stuff"
- Student

"What they teach in school doesnt make sense to me"
- Student

"They (school authorities) failed me last year, this proves anyway that I do not belong here..then why should I come?"
- Student

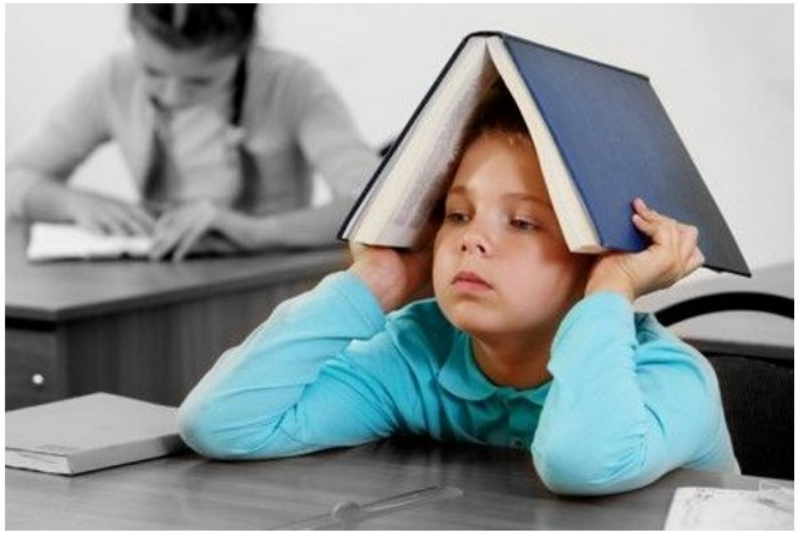


Fig 4: Lack of Interest in class

2.3 Visit to KV IIT Bombay

Fig 6: KV IIT Bombay

KV had a new perspective to throw on the education system. In here, the infrastructure is unquestionably present. Class performance has also been a non issue as most kids are wards of IIT professors and support staff. So, parental psychology towards education was well in place. Students at KV were also facing certain unsaid issues around the motivation and engagement in class.

2.4 Observations from KV IIT Bombay visit

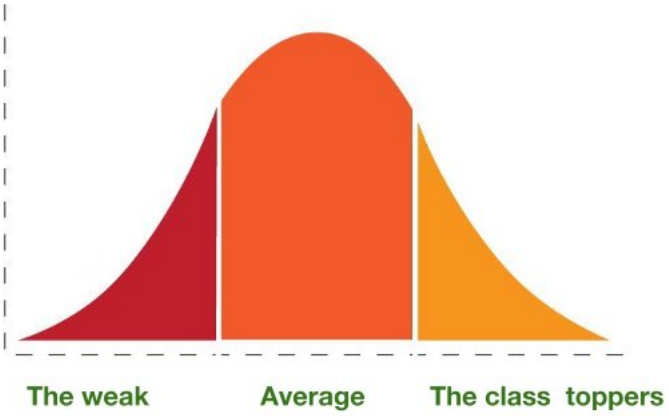


Fig 7: Bell graph showing Types of students in class

In a visit to a KV classroom, one could see the clear distinction between students, the same stands for most schools in the country.

The weak

Do get attention from teachers, as this lot also infamously contains the notorious, but their involvement in class discussions is fairly low

Average

Mostly left out in major class discussions

The class topper

Get the most attention from teachers and are most proactive in class discussions

5. 6 Problem identification process- Analysis

Classroom interaction turned out to be a major factor in engagement

The average student (which forms a bulk of the class) has issues most often unaddressed

Average student

- Mostly left out in major class discussions
- Shyness makes them aviod raising hands
- Fear of speaking out the wrong answer and getting humiliated
- Language or pronunciation inefficiencies
- bad articulation
- Lack of confidence, as the top scorers tend to overpower the discussions

Reasons flagged by most secondary researches also support our learnings from school visits:

- Lack of interest in studies
- Poverty
- Health issues
- Poor quality of education and
- Failure in examinations
- Communication gap between teachers and students

Children from economically backward class are first generation learners in their family and hence their articulation, language skills etc are not at par with many others, this leads to lack in confidence and when a scenario of raising hands comes into picture, they tend to avoid participation

In a class of 40, it is hard for a teacher to pay individual attention to how many students understood a particular concept and how many did not. this way, only the few among the raised hands are chosen. Top of class students and the weakest students get the attention of the teacher here.

Problem identification process

Non graded in-class assessment techniques hold merit in increasing classroom interactions and including the whole class in the process

Non graded discussions are not encouraged, question answers are always looked at a means to evaluate the student and hence increases the pressure.
Active classroom assessments which only focus on learning and not grading are important

"The exams happen at the year end and class tests are also graded and they show in the report card, so it is better to avoid class discussions as it doesnt matter much"
- Student

Issues with the current education system are seen as two faced

Content and Infrastructure side

Engagement of students to keep them motivated

Many government agencies and NGOs are working towards enriching the content of our education system. WIth the advent of gamification techniques and technology in this field it was felt that this area is well take are of

As a part of the design project, merit was seen in addressing the issue of lack of engagement along with bringing in the need for continual non-graded in class assessment

2.5 Current Initiatives

Fig 5: Teach for India

The NGO has taken certain measures to fill these existing gaps in the education system in economically backward regions. Namely:

- Introduction of tablet based learning
- Making the students connect with their Alumni who have gone through the same system and done well for themselves in the community

Major corporations have been coming forward to provide technical aid : Ex, the tablets were introduced by Wipro's Azim Premji Foundation.

Other Non governmental organizations are also working in the same field with different ways to keep the engagement going.
Ex: Teach for India connects young professionals on a sabbatical with a school for a couple of years where they try to revamp

3. Initial design brief

To design a device which helps in quick classroom assessment while enriching engagement and interaction of the whole class

4. Secondary research into existing products

Existing products

1. K-Yan

Knowledge-Yan, popularly known as K-Yan, is an integrated community computer that functions as a computer, projector, and television. K-Yan was developed in a collaboration between IL&FS Education and Indian Institute of Technology, Bombay. The product was created to provide a solution to classrooms that suffered from having too few computers to share effectively among students. K-Yan allows teachers to interactively display information to a whole class

2. Clickers

Clickers are an interactive technology that enables instructors to pose questions to students and immediately collect and view the responses of the entire class.

Fig 8,9 : K-Yan, Clickers both designed in IIT Bombay

4.1 Clickers

What is clicker?

Fig 10: Use of clickers in class

This is how clickers work:

- Instructors present multiple-choice questions (verbally or with presentation software or with the clicker software).
- Students click in their answers using remote transmitters
- The system instantly collects and tabulates the results, which instructors can view, save, and (if they wish) display anonymously for the entire class to see

4.2 Clicker Ecosystem

Computer
Computer is needed to run clicker software to ask questions and to assess results.

Clicker software
Clicker software is one important part of clicker ecosystem. The clicker software is installed on computer. Through clicker software instructor will conduct polling, view and display results and assess the student's performance.

Receiver
Receiver is needed to collect the data from the transmitters

Projector
Projector is connected to the system and to show questions, to view results.

Clickers
Clickers are transmitters given to each student or to everyone who are participating in the polling.

Fig 11: Clickers system

4.3 Current Available models

The clicker ecosystem has changing from time to time. Earlier the clickers were connected to computer through wires. Later IR followed by RF communication. now clickers are replaced by an App.

MimioHub receiver integrates automatically with your MimioVote system.

Fig 12. Mimio vote clicker and receiver

Mimiovote students response system to classroom provide clickers, software for the instructor computer and receiver.

Fig 13 Iclicker REEF software

Iclicker only offer an app that can be installed on smartphones or tablets or laptops of students and can used as clickers and software for instructor computer.

4.4 IIT Bombay clickers

version 1

First version of clicker was developed in**2009**, which consisted of a simple lightweight, portable clicker device with receiver and user friendly clicker software. The data was collected within the receiver which is connected to the computer using RF technology.

version 2

In 2010, second version of the clicker used the same RF technology but apart from that we introduced more set of features like

LCD display, acknowledgement was sent to the student after collecting attendance, different types of quiz were added at the backend software.Hand raise option, when pressed student can ask question through microphone. Microphone Can answer multiple questions(5).

version 3

In the latest version of clickers developed by IIT Bombay , they created a open source software for the Aakash tablet, which combines the best techniques from both the worlds (web technology and android application).
It has two distinct set of features :**Local Mode and Remote Mode**
Local Mode : This mode can be used to conduct an online quiz within a classroom.
Remote Mode : This mode can used for connecting to different colleges and then launch a quiz from one main centre which will be displayed in all connected remote centers through internet connection.

4.5 Clickers advantages

There are many reasons how clickers will change the classroom learning experience. some of the reasons were discussed below

- Good alternative for passive, one way communication of teaching.
- It give opportunity to every student to respond to every question asked by the instructor.
- Outside class teacher can track the individual responses of students, identify their learning pattern and plan lessons according to that.
- The records can also be used for attendance.
- Asking questions in between class i giving periodic breaks it reduces fatigue of continuous listening to lecture.
- Instructor report less sleeping, more discussion, improved alertness during the class.
- Students concentrate better using clickers.

4.6 Low cost audience polling using computer vision

Low cost audience polling using computer vision

Research has done to implement the audience polling with other technology to bring down the cost. One of the research is done by Microsoft India.
This low cost technique uses computer vision for real time polling. In this system teacher asks multiple choice questions orally or on blackboard. Each student will be given a qcard, a printed paper with QR code, with encode student id and options. Students will show their response to the camera which is installed over blackboard and connected to computer. The software will recognize the responses and displays the aggregate of the results.

System overview

1. A printed qcard
2. Camera enabled computer device
3. LCD projector
4. Not completely preserve the identity of the respondent
5. Answers can be influenced
6. 97% votes captures in 15 sec
7. Costs 15 times less cost

4.7 Type of questions

Based on scale of responses

The types of questions for in-class assessment are many:

1. Binary questions- Yes/no type
2. Multiple choice questions- typically a 4 point scale which can be represented as A/B/C/D, else may be a 3 point scale- Yes/No/maybe or 5 point, 7 point depending on the level of sensitivity of questions
3. Alphanumeric questions- answers in numbers, or string of alphabets

It holds merit to finalize the 4 point scale of questions, as many interesting applications can be found, namely

- Instructor can ask questions about the pace, interested or not ,
- Review of the lecture at the end.
- Questions on preunderstanding so that instructor won't waste time on repeating,
- Questions on assignments etc.

Type of questions

which include 2-4 responses typically

Critical Thinking Questions

- You are a triage nurse in a pediatric urgent care clinic and the following patients are waiting. Who would you triage first?
- What other author would agree that economic grievances motivate civil wars?

Conceptual Understanding

Is frog more closely related to fish or human?

A. A frog is more closely related to fish
B. A frog is more closely related to human

Confidence Level Question

How confident were you in answering the previous question?

- Very confident
- Somewhat confident
- Not at all confident

Example Misconception

Which flask will have the highest vapor pressure?

A. 100-mL flask with **10**mL of water
B. 100-mL flask with **50** mL of water
C. Both are the same

Student Perspective Question

Scientists don't really know if the climate is changing.

A. Strongly Agree
B. Moderately Agree
C. Moderately Disagree
D. Strongly Disagree

Facilitate Discussions

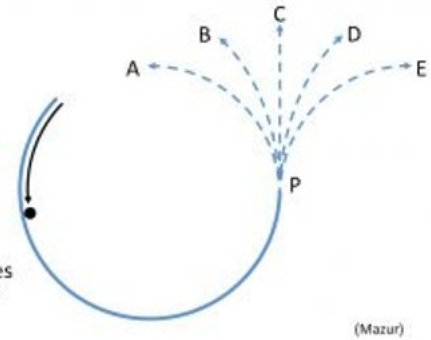
The simplest yet MOST effective method of preventing the spread of infectious disease is to:

A. Undergo an annual physical examination
B. Ensure that your immunizations are up-to-date
C. Wash your hands in between patient contacts
D. Undergo HIV and TB testing at least twice a year

Predicting Outcomes

A ball is rolling around the inside of a circular track. The ball leaves the track at point P.

Which path does the ball follow?



(Mazur)

source:blogs.commons.georgetown.edu/clickers_cop/pedagogy/question-types/

4.8 Problems with existing clicker ecosystem to implement in schools

In India most of the government schools lacks infrastructure like computer and projector for every class. So it is ideal to built the entire system.

- Expensive
- Complicated ecosystem
- Not mobile as computer and receiver are fixed to one class
- Need internet connection
- Lack of ergonomics and aesthetics to the device
- Limited Functions

5. Restated Design brief

Redesigning clickers for schools addressing the following issues

1. Redesign so that it can be mass produced
2. Address issues of cost to reach even the poorest schools in villages
3. Mobile system so that one or two kits can be given to one school
4. Design interface that is user-friendly to children
5. Aesthetically designed such that it can be used by students
6. Easy service and maintenance

6.1 Analysing student response system or clickers

Inside classroom

- Engage students by asking questions and conducting polling
- To assess the understanding of students by conducting polling
- To know students opinion on non academic issues like opinion on pace of teaching by conducting polling
- To make every student to participate in the learning activity

Teacher has to prepare questions and options prior to the class or during class and ask either by presentation or by asking orally.

Feedback from teachers on student response system

- It is an additional burden to prepare questionnaire before every class
- It is easy to make questions for subjects like mathematics and science
- It is difficult to prepare MCQ's for subjects like languages, social studies as they have bounded answers
- Using computer and feeding questions and answers into clicker software might be complicated task every time
- It is useful to plan the next lecture by knowing the understanding of whole class

Outside classroom

- Teacher can assess the results and identify the students who need attention by assessing poll stats
- Teacher can plan the next lecture depending on the student understanding by observing the pattern of responses.

Teacher will assess the whole class and individual performance using clicker software.

- "In a class of 40 to 60 students it easy to assess each student in a short period of time. so there is no need for an separate assessment device" -Teacher
- "Teaching is a dynamic process and it will happen how students are responding during class and planning doesn't help that much" - Teacher

6.2 Pilot test

Depending on the feedback of teachers, building student response system which will fulfil part one will be ideal for schools. Though part two is also needed it will add extra burden on teachers before every lecture to prepare questions and not all teachers are comfortable with using a computer. So the device will do polling and display the results. To understand the in-depth issues in building part one a pilot test is done.

Pilot test

To understand the effectiveness of part one in student response system, a pilot test was done where the questions were asked questions on the board and students were asked to respond using printed cards.

6.3 Observations from pilot test

Student

- student are enthusiastic and eager
- Student find the whole process similar to gaming
- Activity level of the students is higher
- Need to display timer to get responses in time

Teacher

- Teacher is enthusiastic about the whole process and said students response system will improve the classroom learning
- Teacher mentioned that knowing students understanding in real time will help them to plan the class according to the student's responses.
- Preparing questions during the class is not difficult

6.4 Final system concept

Final system

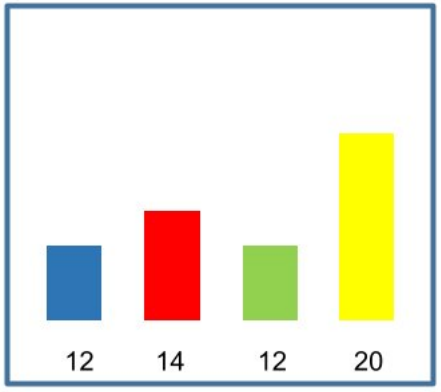
The activity of part one of the clickers or student response system focus on engaging students during class by asking questions and taking responses from every student. The activity helps students to focus better. The results helps teacher assess the students understanding in real time. This helps instructor to further plan the class.

Timer- to get responses in time

Once the teacher asks MCQ question by writing on board, he starts the polling by pressing poll button. There should be a display showing the timer.

Results

Once the timer stops, polling results will be displayed in the form of histogram. It displays four bars along with the number of students. Once the results were displayed , instructor will reveal the answer.



6.5 Building a low cost computer

Raspberry pi is a system on chip originally built to teach basic computer science in schools which costs 25 to 35$. Building an integrated system around raspberry pi is easy as it comes with all necessary ports and works like a pc.

As the system basic operations are to show results and timer which are not heavy computational tasks , Raspberry is ideal

Mini Desktop

Companies like Intel, HP, Asus etc have mini desktops which are basically CPU's packed in small form factor and affordable. user has to buy monitor, keyboard and mouse of his choice to use it. This reduces the price of the computer to few thousands with same performance of a branded one.

The intel NUC model starts from less than 10000 and is very affordable. Building a clicker system using an existing mini desktop would be one approach.

Intel computer stick

Intel computer stick is a full computer built in the form factor of an usb dongle. Its runs full operating system and has HDMI, USB and Audio output. When connected to display it becomes a computer.

✔ Arduino

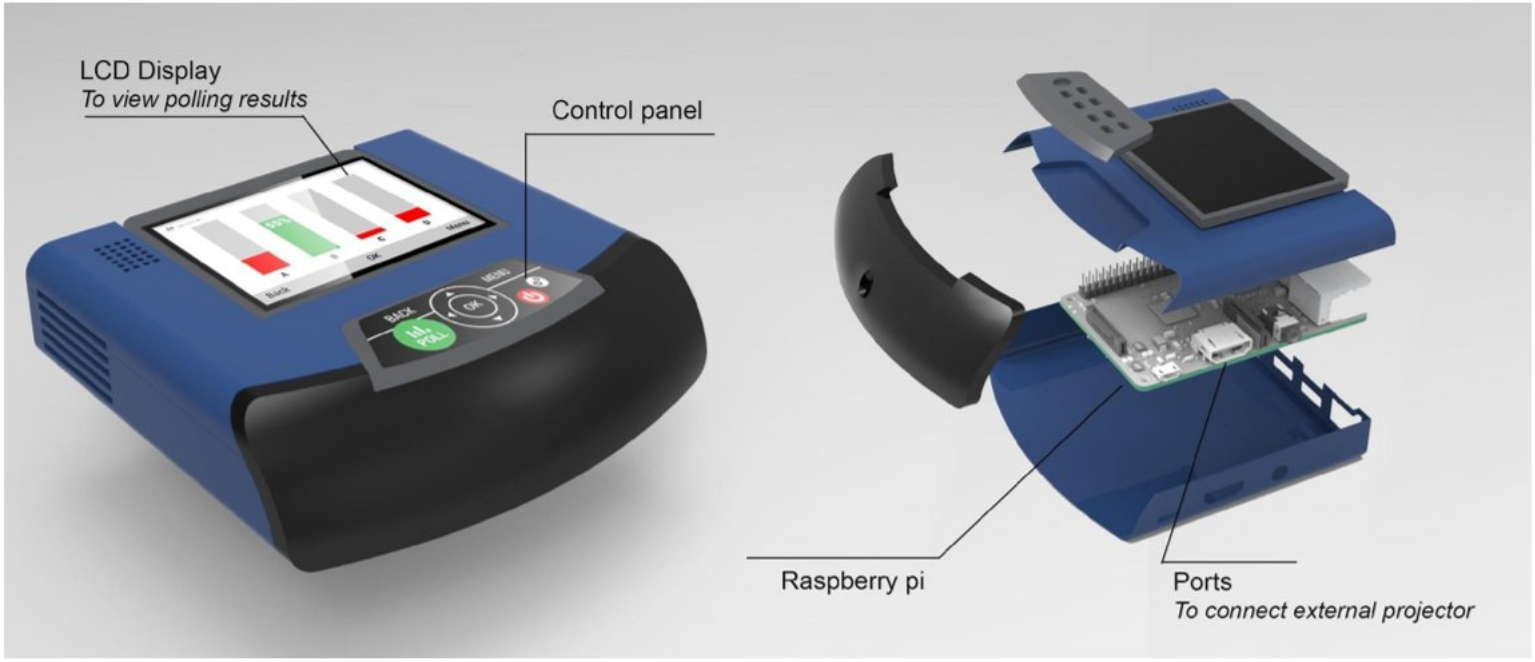
6.6 Projector

Projector is an important part of the system. Projector is connected to the system to show timer and to view results. Viewing the results for students is an important activity as students commit to one answer they will be curious to know the answer.

Type	Lumens	Size
Type of projector LCD, DLP, CRT LCD projector is better over DLP and CRT as LCD is cheaper and have clear image with less lumens	The lumens a regular classroom need more than 2000 lumens projector but since in our case the main purpose is to show questions and histograms a projector with lumens around 200- 500 is enough	The size of the projectors range from pocket projectors to large size projectors. Since it only to show results and timer and less price compared to other size projectors it ideal to use a pico projector or pocket projector. Although there are some downfalls like , less lumens and reliability,

✔ Pico projector

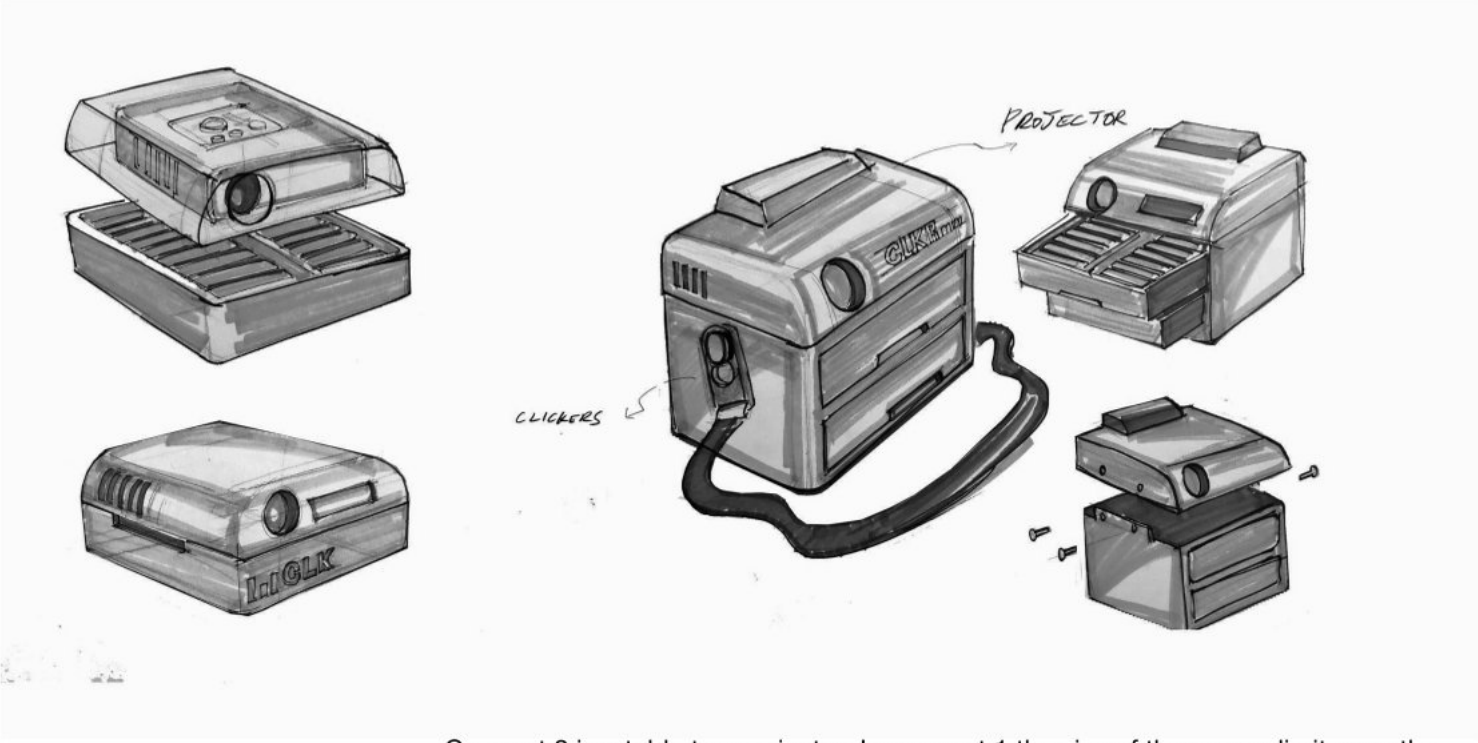
6.7 Concept 1: A portable compact device built over Raspberry pi with small display and integrated receiver to view results



A portable compact device built over Raspberry pi with small display and integrated receiver to view results.

- Single button to start polling and view results
- Since device is built over Raspberry pi, it comes with all basic ports
- Only instructor can view the results and shared with students through orally
- Can connect projector as all ports are available
- Can show multimedia content when connected to projector using usb

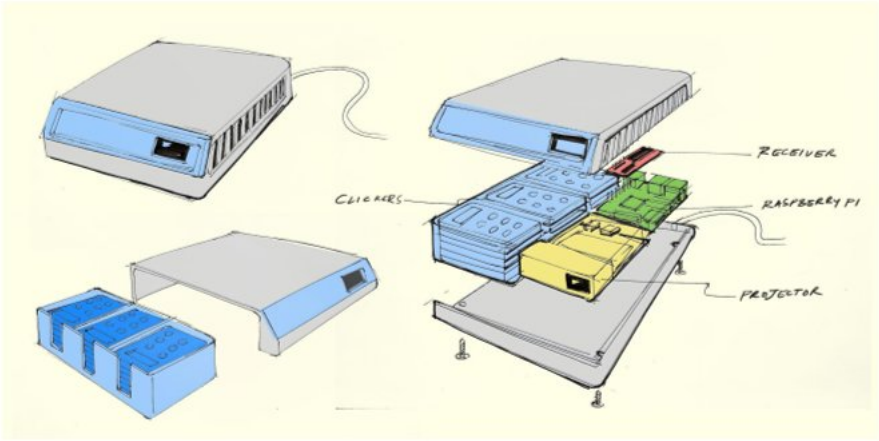
6.8 Concept 2 : Portable projector integrated with raspberry pi and Receiver

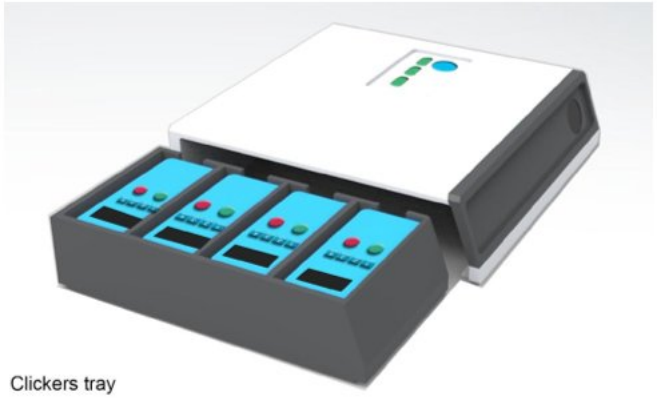


Concept 2 is a table top projector. In concept 1 the size of the screen limits one the instructor can view the results and the students will know the results only when the instructor wishes to share with the class.

In concept 2 a projector is used instead of the screen to make the students part of the system. The results will be displayed to the entire class once the polling is over.

Portable projector integrated with Raspberry pi and Receiver and tripod

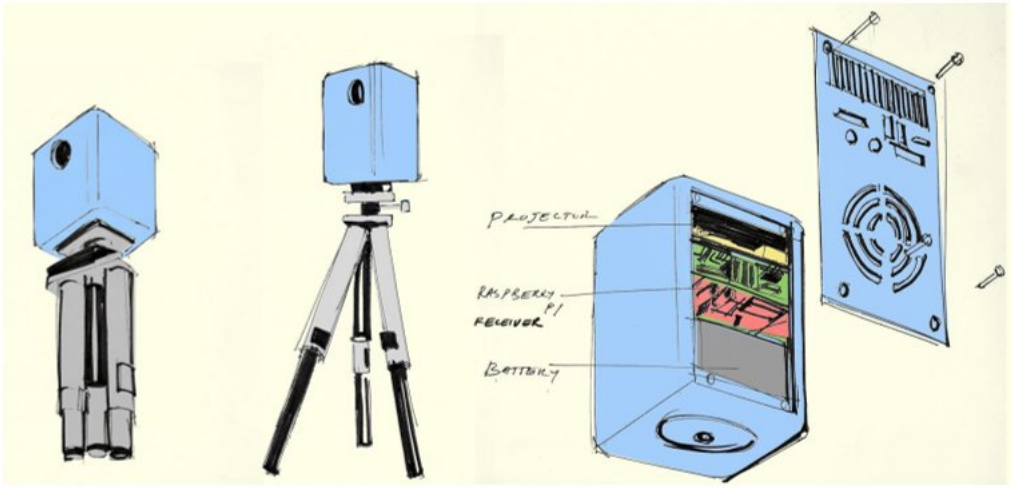




Clickers tray

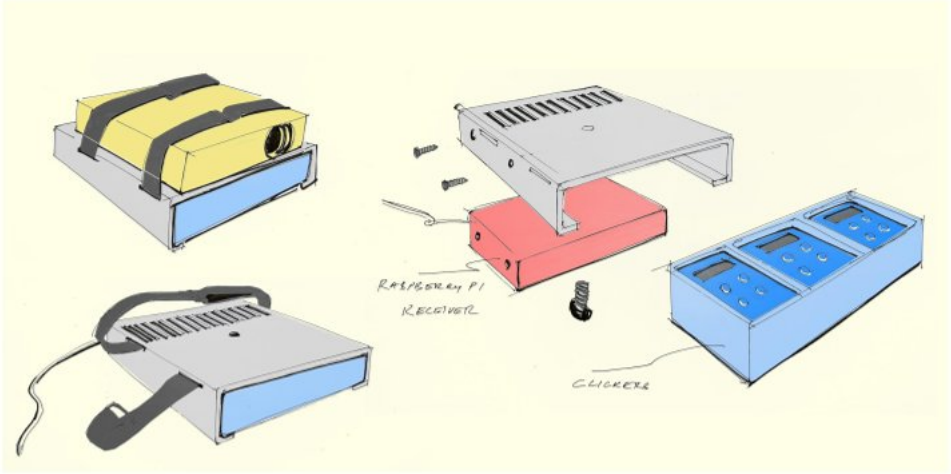
Concept 2 is a table top projector. The projector need a base like table to use. In most of the classes the table will be before the black board. So in order to use the projector we need to find a white wall and the table should be moved to use the projector.

6.9 Concept 3 Portable projector integrated with Raspberry pi and Receiver and tripod



Concept 3 is designed essentially to solve this problem. The integrated system (projector, receiver, raspberry pi) are assembled in vertically one over other to achieve a small cubic form factor. This system when mounted on a tripod becomes more flexible to move to any desirable position in the class.

6.10 Concept 4 Modular concept



Modular concept

Concept 3 is an integrated system of Projector and Receiver on Raspberry pi. If one unit (Projector, Receiver, Raspberry pi) in the system stops working the whole system is of no use till it gets repaired.

Concept 4 is a modular system where the user have the flexibility to use the existing projector or projector of his choice and also can replace any part which goes wrong and use the system with out waiting till the technician repairs.

6.11 Concept 4 Led display Rollup standee using Raspberry pi integrated with receiver

Led display Rollup standee using raspberry pi integrated with receiver

The role of the projector in the system is to project the results in the form of histogram and display the timer so that students will give response before the time stops. Projector is an expensive option. A lcd screen will be also an expensive depending on the size. Another cheap and affordable way of displaying the results will be using led lights. This will reduce the price of the entire setup to many times.

Similar to the led display boards on buses and terminals, it will display the timer and results. The RGB led lights which have high wave length will be clearly visible from longer distance(eg traffic lights).

By using flexible led panel and using the roll up standee, a compact form factor can be achieved. a panel of size 1X1 Mt is large enough to be visible to the entire class.

Using raspberry pi integrated with receiver is built inside the roll up standee. This roll up standee along with clicker will complete the system.

6.12 Concept evaluation parameters

Ease of use, portability, service and maintenance, manufacturing, cost and aesthetics are the parameters for concept evaluation. The parameters are evaluated on a scale of 5.

	Ease of use	portability	Service and maintenance	manufacturing	cost	aesthetics	total
Concept 1	4	4	3	4	4	4	23
Concept 2	3	4	3	3	3	3	19
Concept 3	3	3	3	3	3	4	19
Concept 4	3	4	4	4	4	3	22
Concept 5	4	4	4	4	5	4	25

7 Redesign of clickers for schools

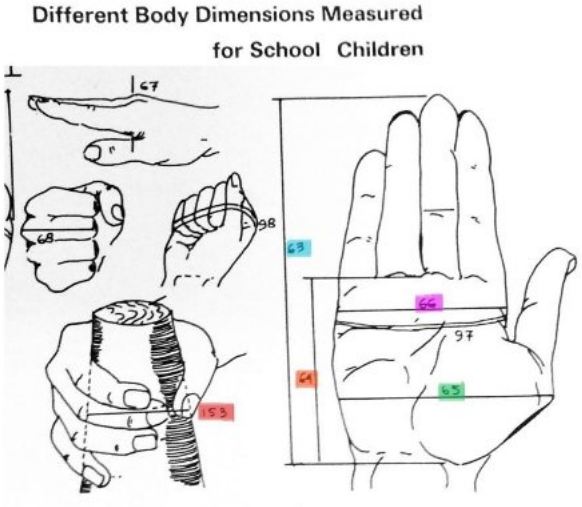
Clicker design

Parameters for designing clickers

- Ergonomic
- Cost effective manufacturing
- Functional
- Interface design
- Tamperproof
- Easily affordable to masses

7.1 Ergonomics of clicker

Hand dimensions of children from age 11 to16



11 to 16 years

	4.7----------5.7cm
	17.1----------19.0cm
	7.3----------8.4cm
	9.8----------11.5cm
	8.6----------10.3cm

The palm dimension of students of age between 11 and 16 are studied. The dimensions suggest

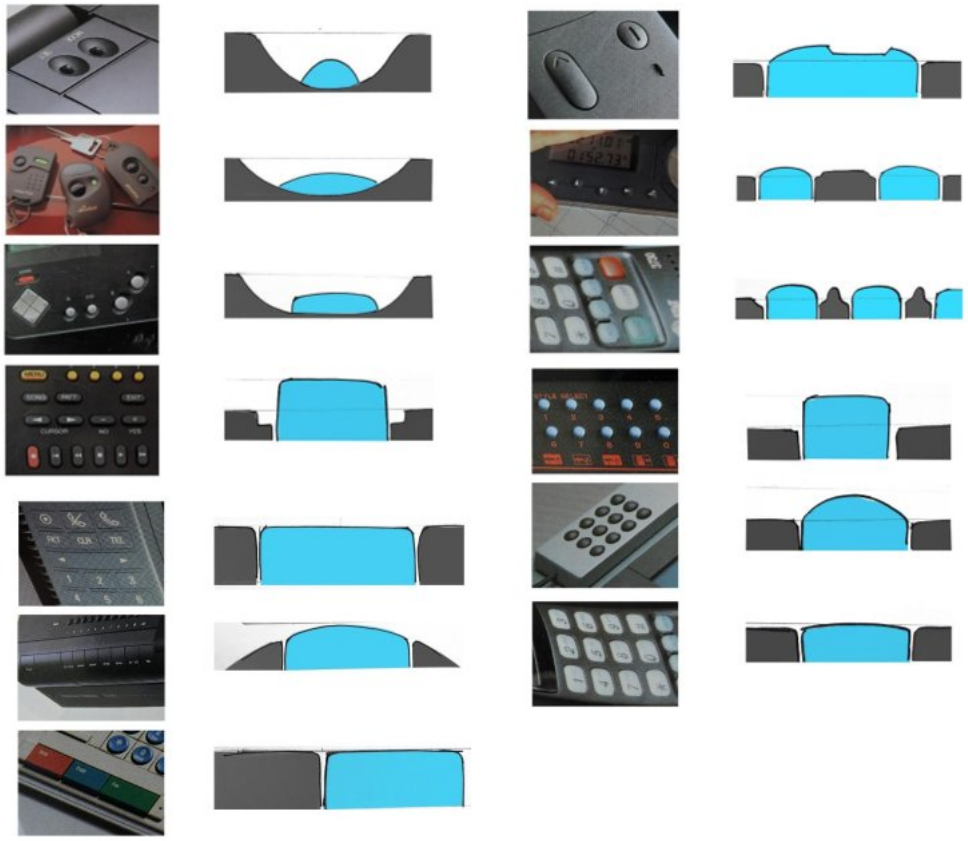
- The width of the device should be of between 40 to 50 mm
- The length of the device should be between 80 to 100mm to be comfortable

7.2 Interface design

The interface of clickers have minimum 4 or more options keys. One confirm or send key.. The four interfaces are of different formats but of same functionality which define different form of the clicker.

- Different forms of clickers are explored with dimensions around 40X100mm and different interfaces. These clickers are given to students of age 12 and questions were asked about the comfort in holding, how easy is it to navigate through the keys
- Remote with 40X80mm dimension fits comfortable in hand
- Moving thumb towards extreme right to press option 4 feels little uncomfortable

7.3 Buttons design



Each product has different remote. The remote of a television set is different from remote of a air conditioner. Different remotes sizes and shapes are studied. Each remote have different type of switches, depending on their function and usage frequency. Some switches are placed below surface level, some are above and some are flushed to the surface level.

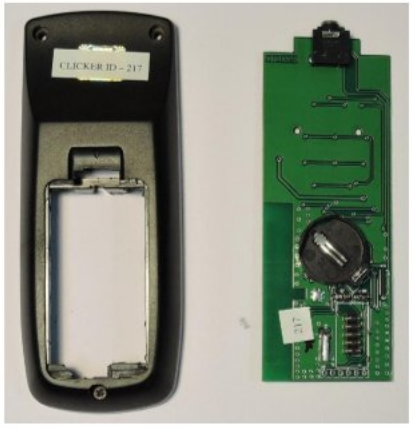
The position of the switches is also decided by their function and ease of use.

Spacing between the keys are different for different functions.

The choice of material and colours decides the comfort and clarity about the keys.

7.4 Power options

Battery powered



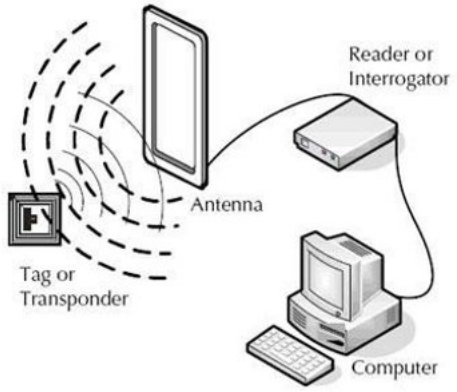
The existing RF based transmitter works with button cell(CR2302). Usually the battery lasts more than 6months to one year depending on the usage. The presence of display also determine the battery life.

since the basic operation of the clicker is to give option. It usually lasts for 6 months to one year on a single cell. So it is ideal to use battery powered clicker.

Solar powered

Clickers can be made working with solar power. A solar chip is included in the clicker.

Using RFID

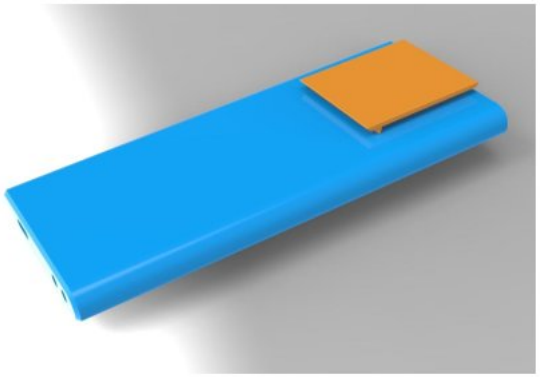


The idea behind considering clicker with rfid is to make the device passive such that no batteries are needed. At present passive rfid tags can be read up to 6 mts distance. The rfid reader will read the cards. Tag interference / reader interference is solved through time division multiple access. In 2009 Favite company built a remote using rfid with out any batteries. Using rfid makes the clickers much slimmer and low cost.

the receiver for rfid remotes will be an rfid reader. This reader should generate a magnetic field to read all the rfid tags and display the results.

7.5 Clicker design

Clip to wear around neck along id band while not in use

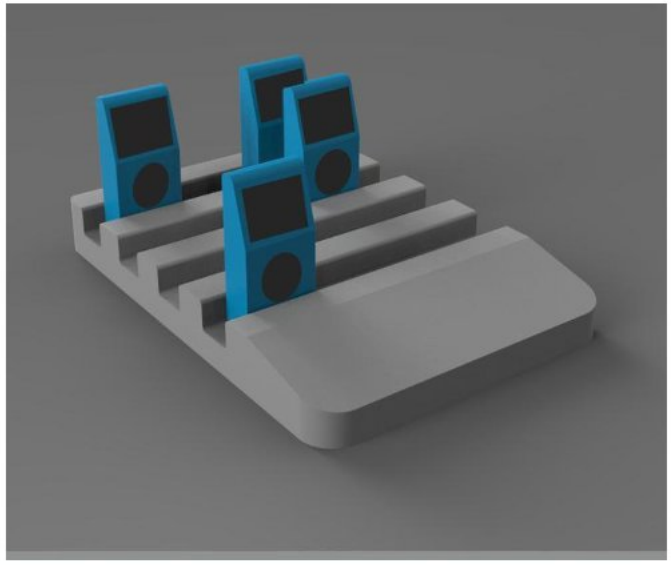


Clip to clip to notebook while not using during class.

Since the whole system is portable and mobile. The width of each clicker matters. The clicker can be made as slim as 5 mm. using membrane switches the thickness can be reduced. By using membrane switches there is great flexibility of printing graphics on the interface. Using a membrane keys is also hygienic as the keys can be swiped to clean.

Taking inspiration from manufacturing and aesthetics of ipod nano , clicker can be simple clean design. The main body will be an extruded flat plastic pipe. The circuit will be inserted from one end and closed at both ends.

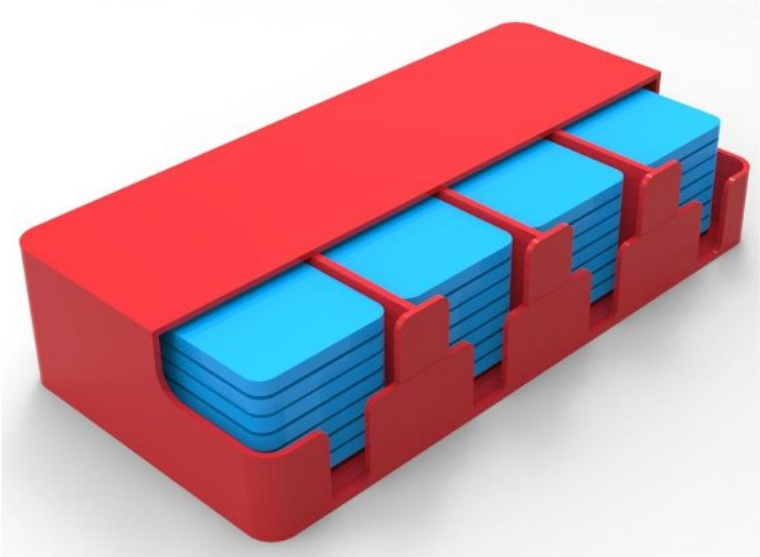
7.6 Storage space



The distribution and collection of clickers is an activity of every day if the clickers are with the school. The process of distributing clickers and collecting should not be a time taking activity. One way of distributing the clickers is giving them in trays. There can be two or three trays per class.

The ingress and egress of clickers from the tray should be easy as students should not spend much time on taking clicker out of the tray or putting clicker back in the tray.

7.7 Tray design



If the clicker has to be placed in one particular way it will take more time for whole class. As the clicker is rectangular and flat on both the sides. There is no directional issues.

After some ideations on the above mentioned issues a semi covered lid with a space on the side to take even the bottom most clicker seems to be a good solution. In this way there is no need for an additional lid to cover the tray from falling.

8. Final concept

Concept 5 Led display Rollup standee using Raspberry pi integrated with receiver

In the previous concepts for displaying timer and results using projector is a expensive option and other drawback are the

- The lumens of pico projector used in previous concepts is around 100 to 200 lumens, so viewing will be very difficult
- To use a projector we need a white background , for which we need either a white screen or white wall
- Even the pico projector is an expensive gadget.

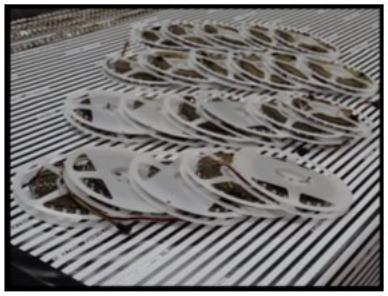
Though the projector can be used showing multimedia content other than main task but it is not mandatory use. So using a LED panel to display the timer and results will be an affordable and completely fulfils the task.

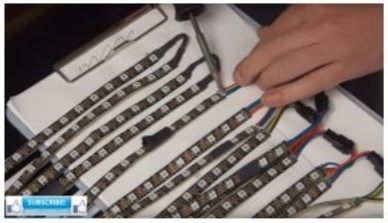
RGB LED display boards

Led display are made of led lights connected in parallel and controlled by a micro controller . It is inexpensive and used for many applications like

(1)To show day by day gold and Foreign exchange/rates
(2)Shopping centers & retail stores.
(3)Its helpful for displaying the information hotels & hospitals .
(4)Display boards use School,Collages and banks.
(5)Traffic Signal

8.1 Proof of concept





Flexible LED display

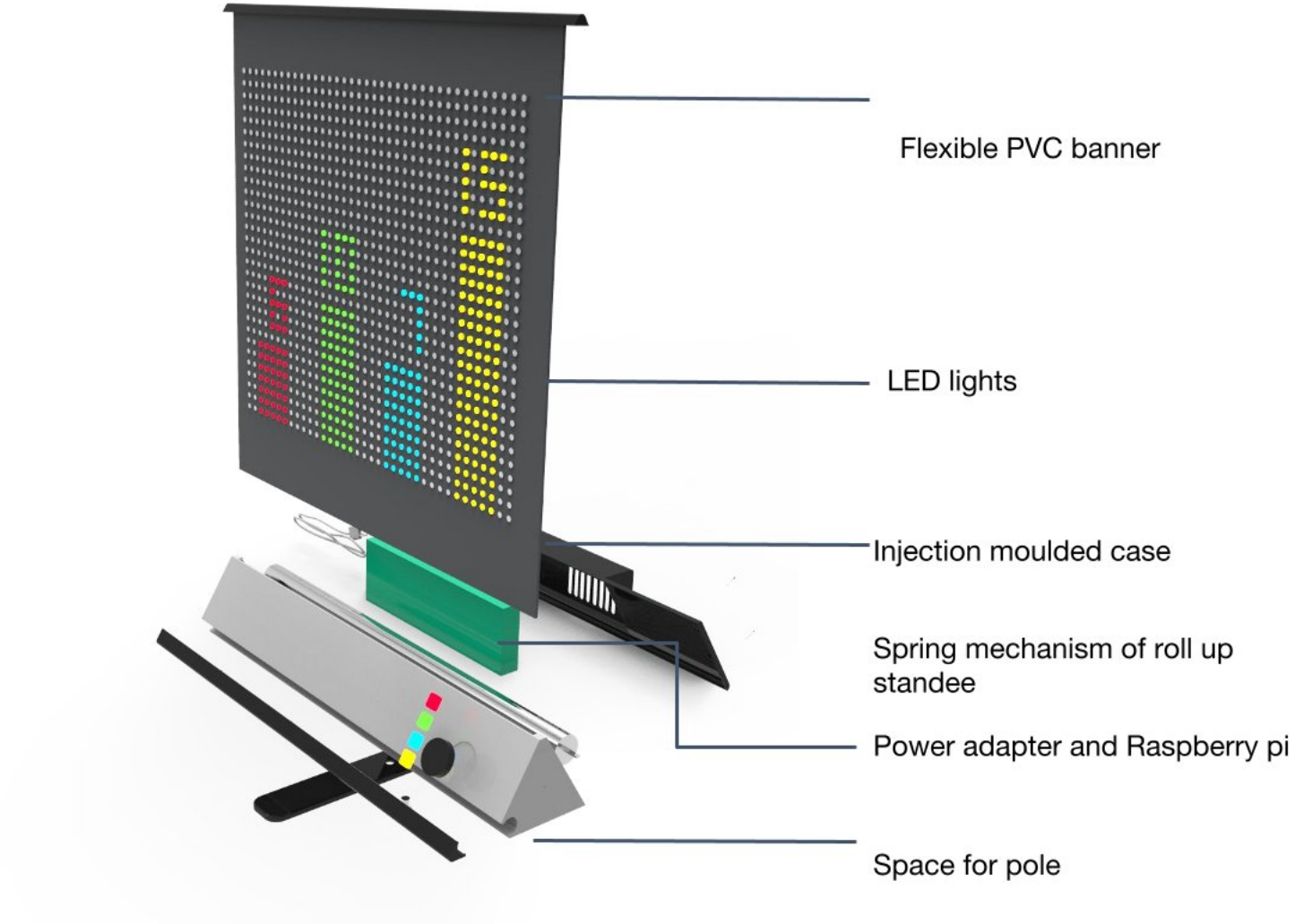
Using one LCD panel of 1X1 mts will take so much space and it will be difficult to carry. Using two or three lcd panels and connecting them while using is another option. But it will increase weight of the whole device. By using flexible led panel the size and rolling while not in use will reduce the form factor many times and the weight of the whole system will also be reduced

by using roll up standee mechanism retracting and rolling can be possible and the led panel will be housed in a case so that it be protected from damaging caused while moving around.

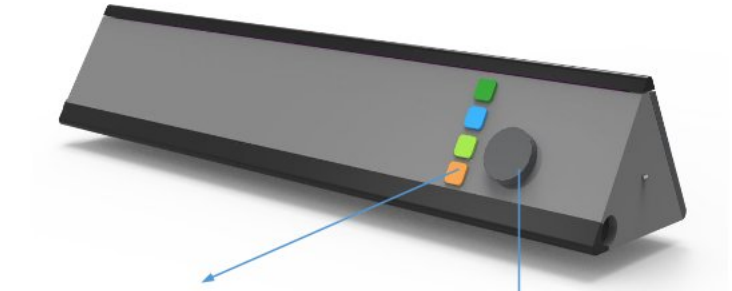
Manufacturing of flexible led display

Strips of led are connected in series and pasted horizontally on PVC banner and on top of it another layer of transparent protective layer is sticked.

8.2 Exploded view

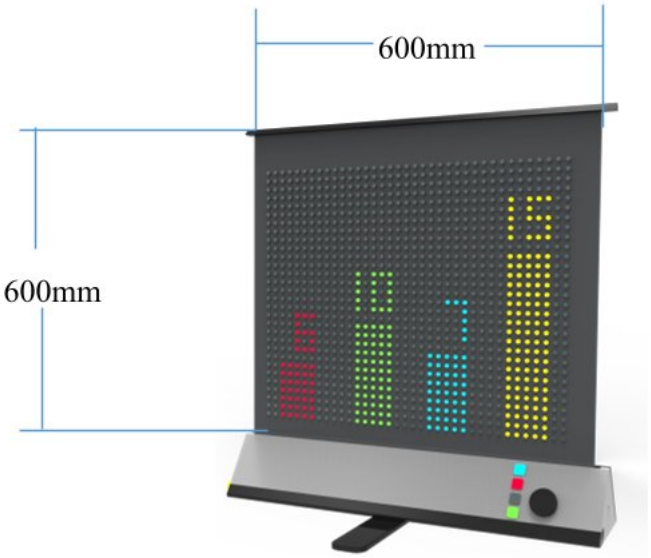


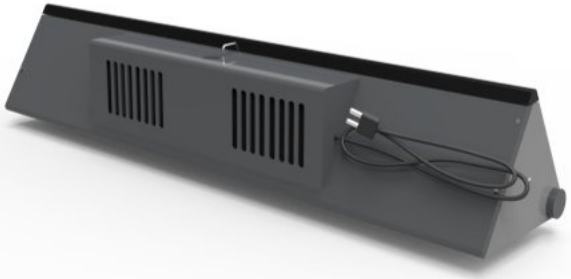
8.3 Dimensions

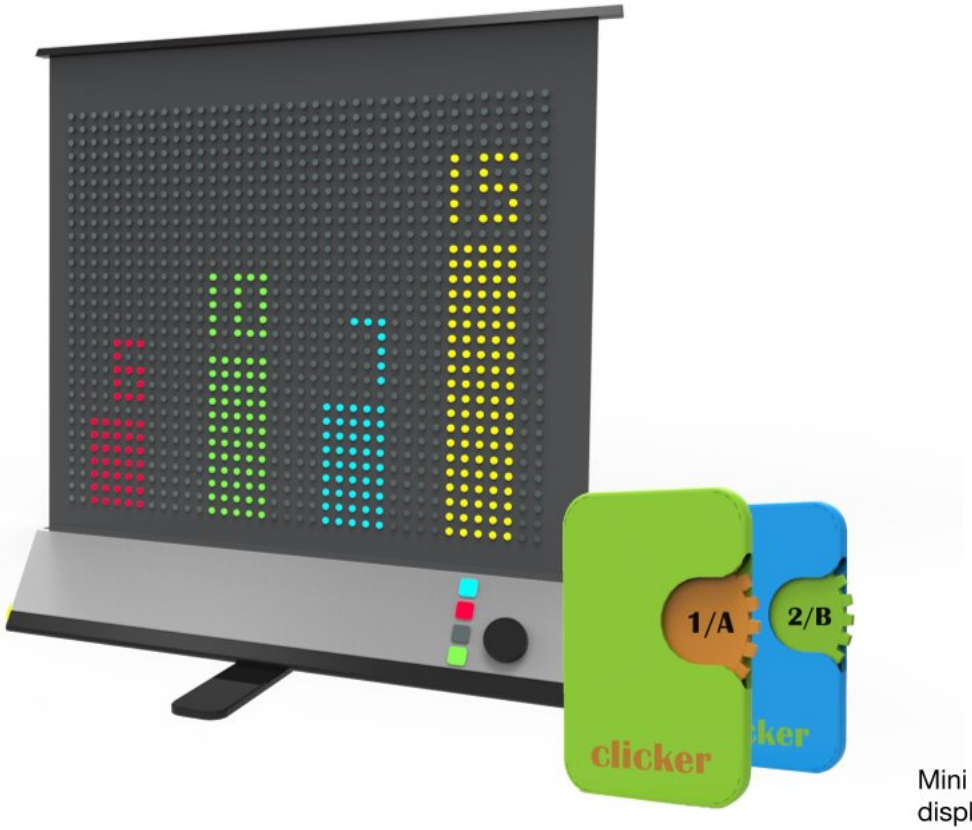


Control buttons

Light intensity control wheel







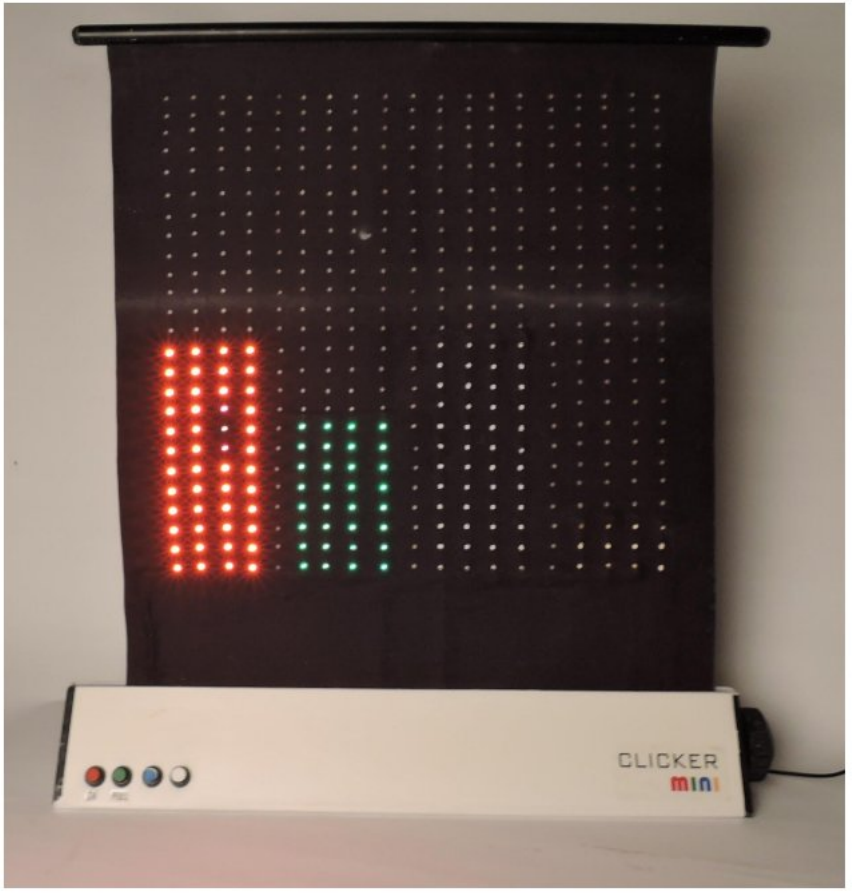
Mini clicker setup, foldable Lcd display and clickers

8.4 Final concept prototype

Mini clicker showing histogram of the results

clickers with minimalistic design


CLICKER
mini


CLICKER
mini

carry case for the entire setup

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